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*Editorial
†Illustrated

Copyrighting Original Articles.

A great deal of labor and thought is sometimes expended in writing a technical article—in some cases the monetary remuneration derived by the contributor being far below the actual value of the time expended. There are, however, other benefits to the writer which are additional, the value of which is difficult to estimate. Among these are the incentive toward original research and the gradually acquired habit of expression in clear, terse English.

Another benefit, and not the least by any means, is the reputation acquired by a writer when his name is associated with certain articles, if they are analytical and constructive, and show keen insight into the problems involved.

In order that we may be sure that our contributors may be properly protected, it will hereafter be the policy of *Railway Engineering* to copyright practically all articles which are the original work of our editors or contributors.

No articles will be copyrighted which are furnished in practically complete form by a railway, as in cases of this kind it is possible that copies may have been submitted to other publications. It is designed only to protect those articles which are, part and parcel, the original work of our writers. Formerly it was considered sufficient protection when the name of the originator of the article was given, other publications giving credit if such material was reprinted. A recent violation of this courtesy has been noted where the only considerable change in the second article was in the first and last paragraph, and credit was given neither to *Railway Engineering*, which published it first, nor to the author, who wrote the article from data in its crude state, nor to the railway—credit being given to no one for furnishing the article or the data from which it was prepared.

Nearly 16 months elapsed between the appearance of the original article in *Railway Engineering* and its recent appearance which makes the following poem unusually applicable:

> "They copied all they could follow
> But they could not copy my mind
> And I left them sweating and stealing
> A *year and a half* behind." —Kipling.

(The italics are ours.)

It would, of course, be futile to copyright abstracts of papers or reports submitted to technical societies, as these are available and become the common property of anyone attending the meetings.

The Panama Canal.

EARLY in 1906 the majority of a board of consulting engineers selected by the administration and including the best talent of this and foreign countries, had reported in favor of a sea-level canal at Panama. The Isthmian Canal Commission recommended the lock type of canal and after much deliberation President Roosevelt recommended this type to Congress. Now that the project approaches completion, it is interesting to note that criticism of the final decision of the United States Congress has not by any means disappeared.

A journal which is representative of persons and affairs technical in England, a foreign power which has taken great interest in the canal project, assumes to criticize much in the manner of its consummation. *Engineering*, of London, calls attention to the fact that the amount of excavation required

by the lock type canal has reached a total of two hundred and thirty-two million cubic yards, whereas the estimate for the sea level construction was only two hundred and thirty-one million. It is also pointed out that the cost of a sea level canal at $247,000,000 was thought excessive, whereas the adopted type had cost up to July, 1913, $299,000,000. The excavation required for the lock canal has risen to 152 per cent of the estimate and is now in excess of that for the sea level canal. While admitting that part of the increased excavating was due to enlargement of the channel, it is pointed out by that journal that a foot of increased width entails less than half the work involved in an equal increase of depth.

We are at a loss to understand the mental process by which *Engineering* has reached the implied conclusion that the advice of the foreign engineers, who recommended the sea level plan, should have been accepted. It would seem that no well-informed engineer could accidentally overlook the fact that the unforeseen difficulties which increased the required amount of excavation for the lock type canal, would have increased incalculably the amount required for the sea level type. The slides of Culebra, furthermore, would, in the opinion of those best acquainted with what has occurred, have made the latter type impossible. The comparison of the cost of excavating a foot in width with a foot in depth can only be regarded as ridiculous in this application. For at Panama a foot in width might stay excavated, whereas a foot in depth might not.

In this discussion, the comparison, for the purpose of arguing the error in the adoption of the lock plan, of the actual cost of this plan with the estimated cost of the sea level plan, can only be termed childish. The estimates for both types were prepared at the same period by practically the same engineering talent. If, then, the estimate in one case was exceeded so greatly, what other conclusion can be consistently drawn than that in the other case the estimate would have been at least as greatly exceeded?

Engineering ascribes the reason for the success of the American engineers in Panama, where the French had failed, as due to the advance in mechanical development in recent years. "Thus have the forces of the United States been assisted in ways of which the early French engineers there had no benefit." Yet in another paragraph it is disclaimed the machinery of the French was inadaptable to the work. For it is shown (truthfully) that much of the mechanical equipment left by the French has been placed in service by the Americans. If, as now seems probable, the commerce ships of England are allowed to pass through the canal under the same conditions as apply to those of our own country, there may be a change in sentiment among the island people as to every feature of the completed work.

Bay City Bridge, G. T. Ry.

IT IS seldom that such exact engineering records are obtainable, after the completion of a railway structure, as were procured in the article on the Bay City Bridge, which appears elsewhere in this issue. This fact is exemplified in the cost data presented, which were carefully kept and are accurate, having been confirmed in detail by the contractors.

The engineering profession has long been warned to use cost data only with exceeding discrimination, and to carefully take into consideration the conditions obtaining on the work from which the data were taken, as well as the conditions to be encountered where the data are to be applied. For these reasons, as detailed a description as possible has been given of the conditions at the Bay City Bridge. This, together with the plans showing the nature of the subsoil and underlying strata, the depth of the excavation below water level, etc., should convey a sufficiently exact idea of the conditions under which these data were obtained.

The data as given show some very moderate costs, some of which are due to the use of wooden cofferdams with their lower initial cost. The character of the river bottom was very favorable for driving piles, although doubtless better results might have been obtained with a steam hammer.

The work was carefully planned, which always tends to reduce unit costs. The only difficulty in the execution was due to the substructure contractor's inability to keep ahead of the superstructure contractor, which undoubtedly somewhat increased the costs to the latter.

Annual Convention, Wood Preservers' Ass'n.

THE tenth annual convention of the American Wood Preservers' Association was held in St. Charles Hotel, New Orleans, La.

This meeting surpassed any previous one in the value of the reports and papers submitted. The standing committees are beginning to get some valuable work under way, work that is of increasing importance to all railways.

Brief abstracts of some of the papers and reports of interest to railway employes, are contained in the report published on another page of this issue.

These papers have been very considerably condensed for the following reasons: (1) Complete copies of the original papers or reports may be obtained by interested persons by addressing F. J. Angier, superintendent timber preservation, B. & O. R. R., Mt. Royal Station, Baltimore, Md.; (2) The printing of this report in full would have left little room in this issue for other articles.

It has been attempted, however, to give a sufficiently clear resumé of the different papers to show the principal ideas in them, and to enable the reader to determine whether he wants the complete original paper to add to his file.

Industrial Railways.

THE American people are as a class fair minded and the methods used by the daily press in treating certain subjects often causes doubt in the mind of the thinking man as to its proper representation of the public in this country. Those associated with the railways probably have more reason than those associated with any other industry to wonder at the attitude of the press in treating upon subjects which concern the railways.

It is only recently that articles appeared simultaneously in the leading daily papers of the country to the effect that several of our large systems have been caught in a species of "rebating." It would not be surprising, if it were possible to know, if hundreds of thousands of minds had formed the opinion based upon these items, that the railways are still open to criticism with respect to such matters.

It is only in later issues of these same newspapers, if at all, that it is explained that the railways themselves instigated an

investigation on the part of the Interstate Commerce Commission into the particular specie of rebating above referred to. It is well known among business men that the larger industrial concerns have built and maintained their own railways for the purpose of obtaining allowances from the large railway systems in the form of switching charges and per diem rates on cars. The advantages of this practice on the part of large manufacturers have been so great as to encourage a very large increase in the number of railway companies incorporated to operate plant tracks and locomotives, and have led to a situation which has become embarrassing in several respects.

The Pennsylvania, the New York Central, the Baltimore & Ohio and the Erie have filed briefs on this subject with the Commerce Commission for the purpose of obtaining a ruling as to the legality of the practice, and it is probable, as a result, that all allowances for the performance of this class of service will be abolished. There was absolutely no secrecy about any phase of the subject, as has been publicly stated by Samuel Rea, president of the Pennsylvania System. It is plain to see, therefore, that another grave injustice has been done the railways generally by the method used by the daily press in handling the subject. The probable outcome of the matter will be the disbandonment of most of the railway corporations formed for the purpose of operating manufacturing plant tracks, as there will be no further incentive for their existence.

Twenty Years Ago This Month

(From the Files.)

A concrete arch with a span of 164 feet and a rise of 16.4 feet has recently been built over the Danube river at Munderkingen, Wurttemburg.

H. W. Reed, president of the Roadmasters' Association of America, has resigned as master of roadway of the Savannah, Florida & Western to enter a banking business.

On Feb. 17 an unfinished bridge span on the Chicago, Milwaukee & St. Paul, near Ellis Jct., Wis., fell carrying with it fifteen men.

A. H. King* has been appointed superintendent of bridges and buildings of the Wyoming division of the Union Pacific.

Severe winter storms have caused the failure of two miles of snow sheds on the Central Pacific in Nevada.

Surveys have been completed for a canal across the state of Michigan.

The Pennsylvania has just completed a three-track, deck Pratt truss bridge across the Schuylkill river at Philadelphia.

J. A. L. Waddell, of Kansas City, Mo., has been appointed chief engineer of the Jefferson City Bridge & Transit Co., which proposes to build a railway and highway bridge over the Missouri river at Jefferson City, Mo.

In the exhibit of the Pennsylvania at the World's Fair there was shown the original 20-lever frame used in the first interlocking plant in the United States. It was erected by Saxby & Farmer in 1874 and interlocked the crossing of the Center Street branch and the main line of the Pennsylvania, one mile east of Newark, N. J.

Beds of sawdust 40 to 50 feet deep and under 50 feet of water, are causing trouble to the engineers who are planning the foundations of the new inter-provincial bridge over the Ottawa river.

The final survey for the great bridge over the Mississippi river at New Orleans, has been commenced by Chief Engineer E. L. Corthell. The main channel span will be 1070 feet long. The two connecting cantilever spans will be 602 feet long, each; making a total length of 2,274 feet for the river crossing. There will be a clearance of 85 feet at high water mark.

The Lehigh Valley is equipping that part of its line between Mauch Chunk and Penn Haven with Hall automatic signals.

G. W. Vaughan* has been appointed engineer maintenance of way of the New York, Chicago & St. Louis.
& Hudson River.

The Chicago, Milwaukee & St. Paul has just put into operation over its whole line, from Chicago to Council Bluffs, the manual block system, previously is use on short portions of the line.

The first practical trial of rails welded at the joints will be made on the Baden railway which, preliminary to changing to electric power, has let the contract for the track work. The railway is an extension of the Broadway cable road in St. Louis. The rails will be continuously welded throughout the three and one-half miles of double track. The experiment is viewed with much skepticism.

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* Now Supt. B. & B., Oregon Short Line.

* Now engineer maintenance of way of the New York Central

NATIONAL DRAINAGE CONGRESS.

The fourth annual meeting of the National Drainage Congress will be held April 22 to 25, at Savannah, Ga. The floods of 1913 are still fresh in the minds of many railway employes, and the enormous losses in that year have aroused railway offcials to the necessity for using the most stringent and effective preventives. It is probable, therefore, that the employes of railways are one of the classes most interested in the work of this Association.

The following figures have been prepared by the Association and the enormous losses that these total, compel the attention of all students of conservation:

Annual property loss from floods	$200,000,000
Annual loss from malaria and other swamp diseases	162,000,000
Total	$362,000,000

In addition to this there is the incalculable loss of life and impaired health which cannot be reduced to figures.

It is estimated that at least 75,000,000 acres of swamp land can be reclaimed, which should add about $1,000,000,000, about 20%, to the average annual crop values. This enormous increase in the productivity of states already traversed by numerous railway lines will mean greatly increased business without further extension, or at least with inconsiderable extension to present facilities.

In 1911 Presidents Winchell and Bush of the Atchison, Topeka & Santa Fe and Missouri Pacific Railways showed their keen interest in the subject of reclamation by the following telegram which is self-explanatory and which was sent to Secretary of the Interior Fisher just before starting on an inspection trip:

"There is no movement today of more importance than the reclamation of our swamp lands, affecting both health and prosperity, and while your party is organized we ask that you also include in your itinerary a trip over that part of the railway lines which we represent which traverse swamp lands on the west side of the Mississippi River crossing either at New Orleans or Baton Rouge as best suits your schedule, and coming north through Louisiana, Arkansas and Missouri, as far as Cape Girardeau. In southeast Missouri you can inspect extensive drainage operations which have been completed and which are in progress."

The National Drainage Congress prepared and supports the bill introduced by Speaker Clark and Senator John Sharp Williams which provides for immediate protection from floods and reclamation of swamp and overflowed areas, the government doing or supervising the work, with $30,000,000 made available to start the work.

Bay City Bridge, G. T. Ry.*

The Grand Trunk Ry. has recently completed a seven-span structural steel bridge at Bay City, Mich., which embodies a number of features of interest. The bridge has two draw spans, 250 ft. center to center of piers, and five spans, 160 ft. center, to center of piers. Indicative of the careful work followed throughout in the design of this structure is the fact that although designed primarily for Cooper's E-50 loading, three different loadings were assumed in design, and the effect of heavier loadings on the members was taken into consideration.

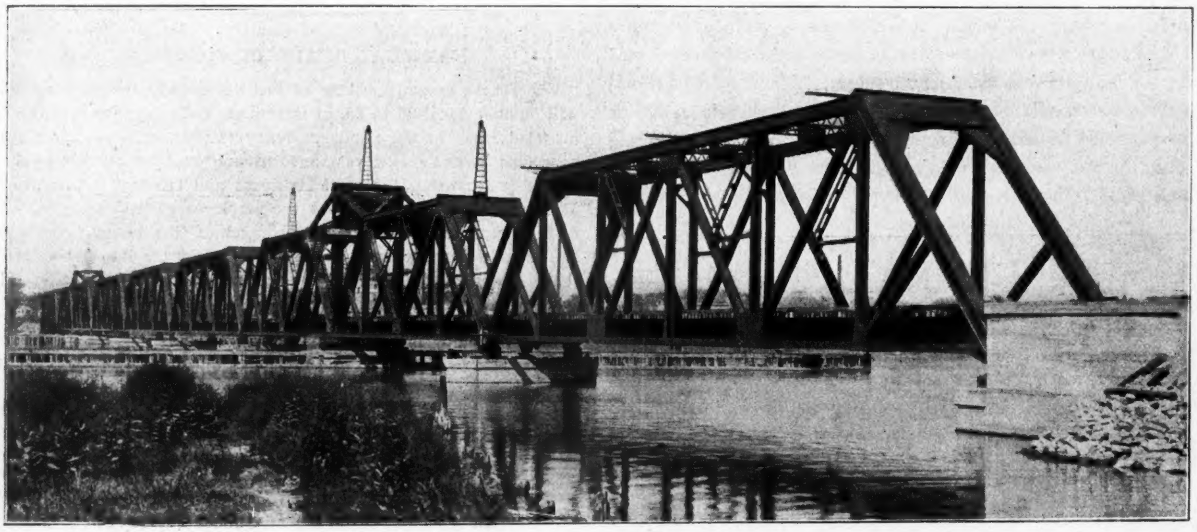
The line on which the bridge was built was formerly the Cincinnati, Saginaw & Mackinac Ry., running from Durand to Bay City, Mich., the latter being the present terminus of the line. This line is one of the most important feeders of the Grand Trunk Ry., connecting with the latter at Durand. At North Bay City a connection is made with the Detroit & Mackinaw Ry., which runs north along the lake (with numerous feeders) terminating at Cheboygan.

clay on the east bank. The east channel was deepened to 24 ft. below mean low water in 1911. It is expected that the other channel will be deepened in the future.

The stream bed is comparatively stable. It is covered by considerable alluvium which shifts from time to time, making it necessary to deepen the channel about every five years. This shifting was not serious enough to be taken into consideration by the United States engineers, however, in locating the positions of the opening spans.

The river is from 8 to 23 ft. in depth, and fluctuates only about 6 ft. from low to high water. The location is so near the mouth of the river that the stage is governed almost entirely by the fluctuations in Lake Huron, and the latter depend on the directions of the winds. The current at flood tide is about 5 miles per hour, and at low tide is about 2 miles per hour.

The above facts show that the behavior of the river imposed very few restrictions on the design. There is little danger of the



Bay City Bridge, G. T. Ry.

Bay City is divided into two parts by the Saginaw River, and until the recent improvements West Bay City was the terminus of the Bay City Terminal Ry., which is the name under which the improvements were made. The old terminal was over a mile from the center of East Bay City, which comprises 70 per cent of the population, and in 1910 the management decided to extend the line across the river and into the heart of East Bay City, an undertaking involving considerable expense, but which adds greatly to the convenience of the public. As in many terminal improvements, the added revenue is not commensurate with the cost. However, crossing the river materially improves freight as well as passenger facilities.

As the extension is only for traffic originating or consigned to Bay City, a single-track bridge was installed and will undoubtedly have ample capacity for many years to come, the entire population on both sides of the river now being in the neighborhood of 60,000. The city has had rapid growth in the past, increasing from 28,000 to 45,000 (63 per cent) in the decade 1900-1910.

The width of the river at crossing is over 1,000 ft., but the line of the bridge is on a skew, making it 1,300 ft. face to face of abutments. The river will have two navigable channels at this point, necessitating two movable spans. The banks are very low with sand outcropping on the west bank, while the layer of sand is covered with a deposit of soft alluvial mud and

*Copyright 1914, W. E. Magraw.

river channel moving, nor is there any danger of extreme high water, which would necessitate a high level bridge. A high level bridge would have been considerably more expensive since the banks are low.

The bridge is tangent throughout, located at an angle of about 70 degrees with the general direction of the stream. The piers are skewed at an angle of 80 degrees with bridge tangent, the latter bearing north 85 degrees 1 minute east. The grade is level across the entire bridge.

Substructure.

The strata underlying the river bed was investigated by seven borings. These showed first mud, and then alternate layers of sand and clay, in varying thicknesses, to a depth of about 50 ft., where hardpan was encountered. A few feet below hardpan solid rock was found. The boring data, however, proved of little real value in the construction of this bridge.

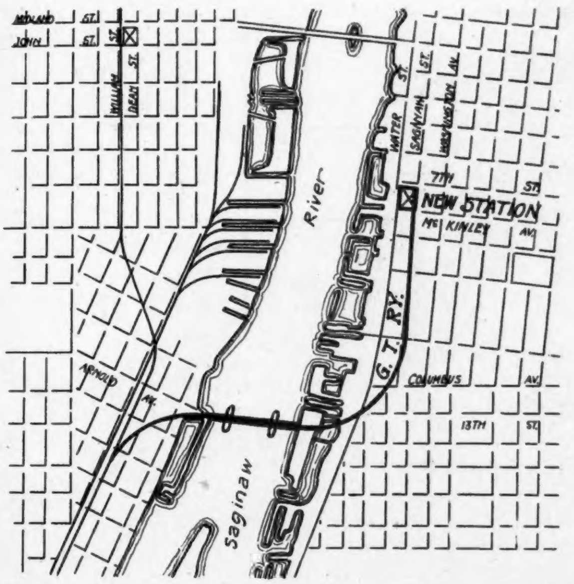
The carrying capacity of the subsoil immediately below the bed of stream, was found to be very little from several tests on short piles driven prior to construction. It was therefore thought advisable to found all of the footings on piles, loaded at 20 tons each. Test piles were driven at each pier site and lengths necessary were thus determined.

The sub-structure consists of six rectangular piers, each with starkwater on the up-stream side, two circular pivot piers for swing spans, and two U abutments.

The rest piers, 1, 3, 6 and 8, are all the same size. The foot-

ings are 39 ft. by 15 ft., supported on 67 piles spaced on 2 ft. 11 in. centers transversely, and 2 ft. 6 in. longitudinally of the pier. The piles are 36 ft. long under pier 1, 33 ft. long under pier 3, 29 ft. long under pier 6, and 36 feet long under pier 8.

The footings are reinforced just above the tops of piles, with ¾-in. round rods, spaced on 18-in. centers, both longitudinally and transversely. The body of pier is 27 ft. 6 in. (exclusive of starkwater) by 11 ft. 6 in. at bottom, with a batter of 1 in 24 on all faces, the dimensions under coping being 25 ft. 4 in. by 9 ft. 4 in., the height of pier from base of footing to top of coping being 33 feet.



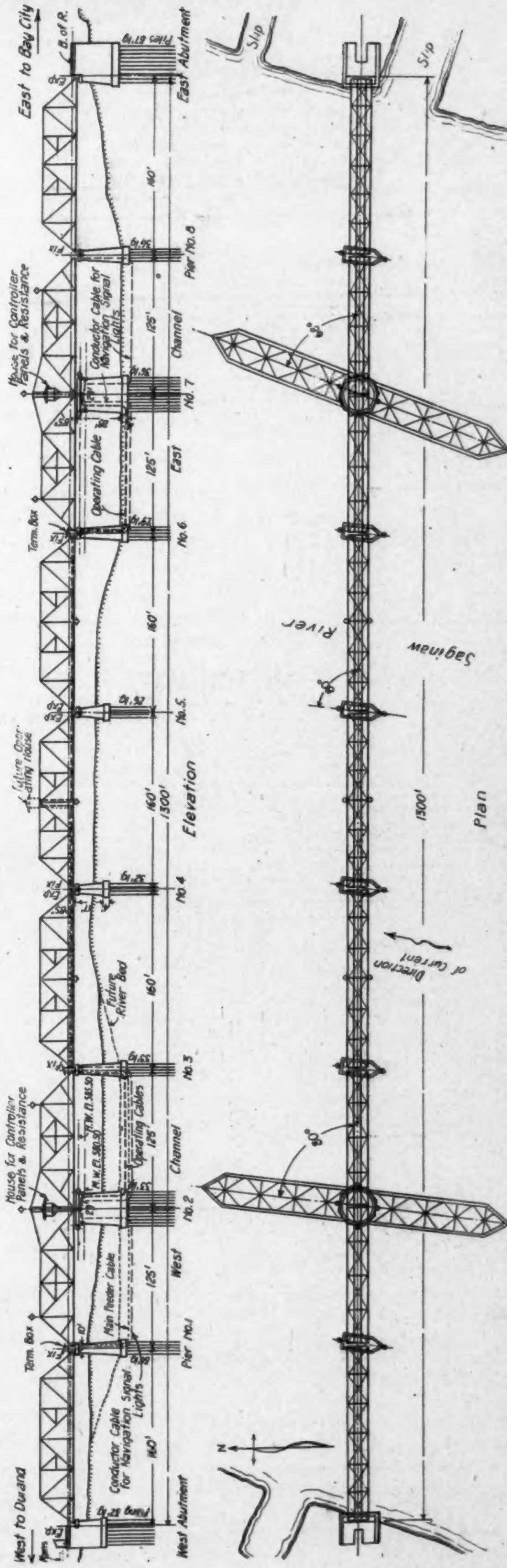
Extension from West Bay City to East Bay City; Location of Bay City Bridge.

The coping 2 ft. thick extends 3 in., with rounded fillets below, and a 3-in. champfer on top. Reinforcement of ¾-in. bars on 18-in. centers is provided both longitudinally and transversely, similar to that in footing, located 12 in. below top of coping.

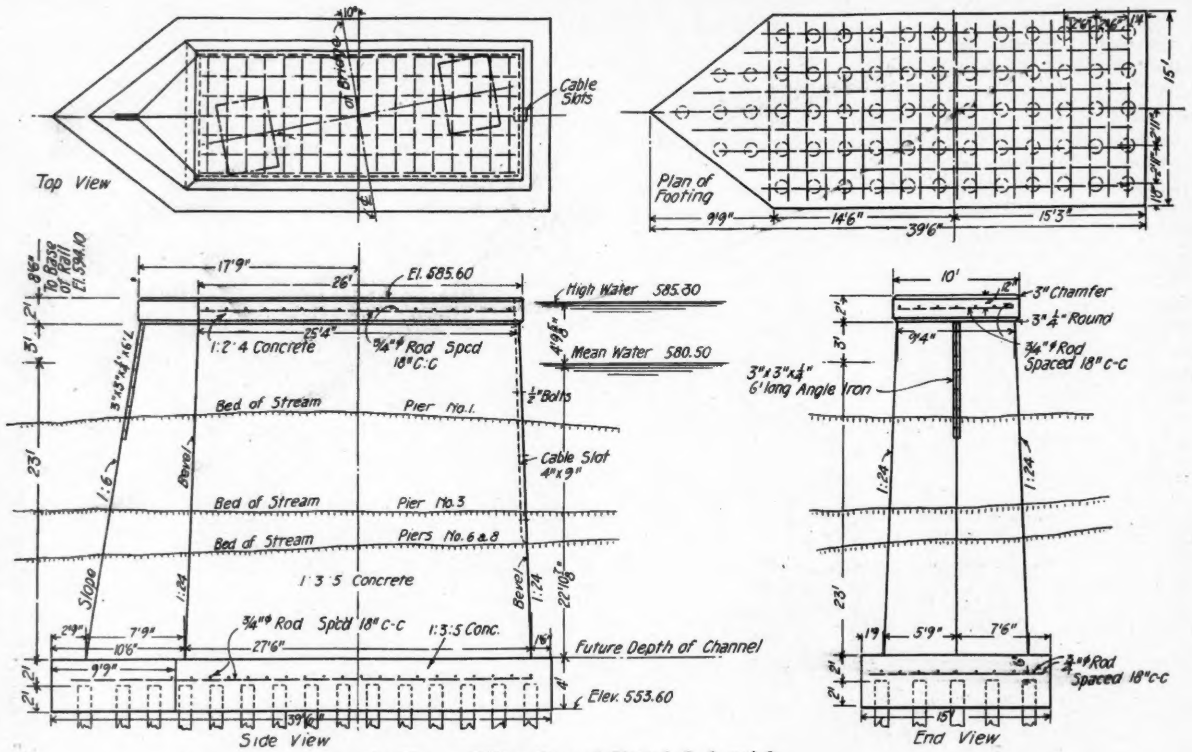
The starkwater extends 7 ft. 9 in. at the bottom, with a slope of 1 in 6. The edge is protected by a 6-ft. nose angle 3x3x¼ in., shaped to nose of pier and secured to the concrete with seven anchor bolts ⅝x8-in., with countersunk heads.

The reinforcing, 1,339 pounds per pier, was added, according to usual practice on the Grand Trunk Ry., as an additional factor of safety against unequal settlement or loading, and was not figured on in the design of piers. The footings and bodies of piers were a 1:3:5 mixture, and the copings were 1:2:4. The bridge seats were finished with a 1½-in. top coat of 1:2 mortar of cement and granite screenings, applied before the concrete had set.

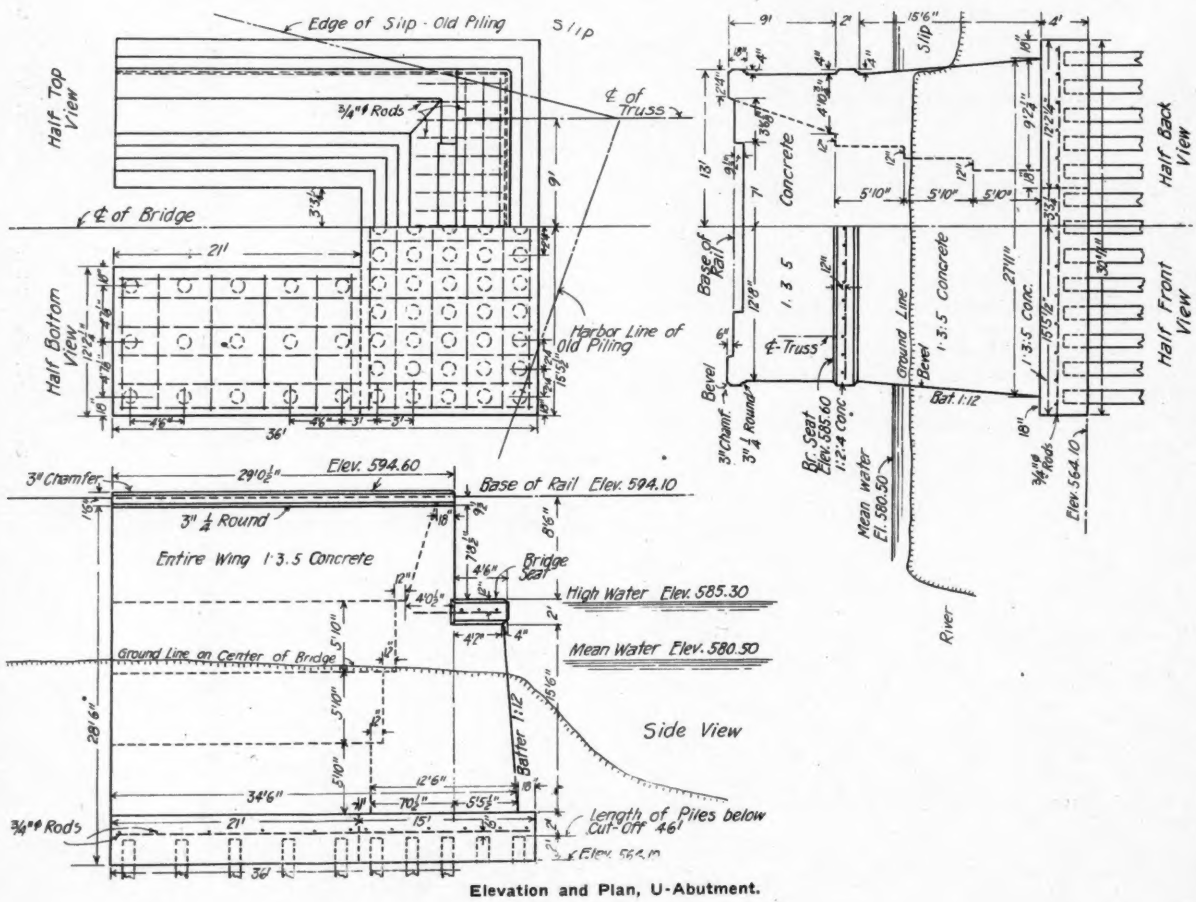
These piers were designed with tops of footings at the present or future depth of the channels. Intermediate piers 4 and 5 are similar to the rest piers in design, their height, however, being but 21 feet over all. The footings, 4 ft. thick, 13 ft. wide, and 28 ft. 1 in. long, with a triangular footing extending 8 ft. 5½ in. further, under the starkwater, rest on 51-ft. piles spaced 3 ft. 4 in. transversely and 2 ft. 6 in. longitudinally, with 51 piles in all. The design is exactly similar to piers 2, 3, 5 and 7 described above, all the dimensions being made smaller because it is almost certain that no radical change in the channel will occur at these points. Pier 4 has 32-ft. piling, and pier 5 has 26-ft. piling. The pivot piers have hexagonal footings 34 ft. across and 4 ft. thick, and are supported by 120 oak piles, 33 ft. long at pier 2 and 36 ft.



Plan and Elevation of Bay City Bridge, Showing Profile of River Bottom, Penetration and Lengths of Piling, and Electrification Cables.



Plan and Elevations of Piers 1, 3, 6 and 8.



Elevation and Plan, U-Abutment.

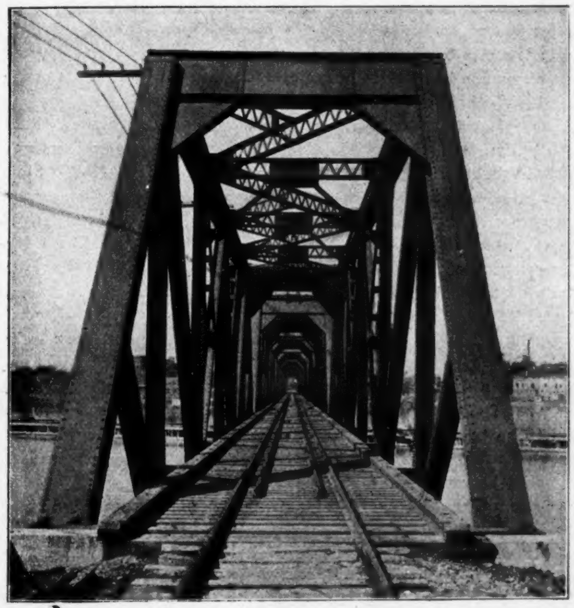
long at pier 7. The face of the body of pier is circular, and is set back a minimum of 1 ft. 9 ins. from face of footing, giving a diameter of 30 ft. 6 in. The batter is the same as in the other piers, 1 in 24, giving a thickness of 28 ft. 4 in. under coping. The height is 32 ft. from bottom of footing to top of coping.

Piles are spaced on 2 ft. 9 in. centers, and are cut off at center of footing, or 2 ft. above the base. Longitudinal and transverse sets of ¾-in. round bars are located in the center planes of the footing and coping. These piers have no starkwaters, but are protected by long timber breakwaters. The concrete mixtures used were the same as for corresponding parts of other piers.

All channel piers were founded 27 ft. below mean stage of water. The sand at the west abutment and piers 1 and 2 was firm, and during the construction it developed that a good foundation could be obtained without piles. Considerations of greater safety, however, led to the use of the entire number of piles shown in the original design.

U-Abutments.

The massive U-abutment on the east side has footings 4 ft. deep, 30 ft. 11 ins. wide and 15 ft. thick, with tail walls 21 ft. deep and 12 ft. 2¼ in. wide. Piles under the front wall are 3 ft. centers longitudinally and 2 ft. 4 ins. transversely, while under the tail walls they are spaced at 4 ft. 6 in. centers longitudinally, and 4 ft. 7½ in. transversely. The back wall is of plain concrete 1 ft. 6 in. thick at top, with a back batter of about 1 in 3. The back batter on the top sections of tail walls are also 1 in 3, while the face batter on each is 1 in 12. The front and side faces and the backs of tail walls are set 1 ft. 6 in. from face of footing. The back of the face wall, however, is only 12 ins. from the back of footing. The front and tail walls are all stepped back with three 12 in. offsets at 5 ft. 10 in. intervals, above the top of footing. All offsets except the top ones have vertical faces.



End View, Bay City Bridge.

The bridge seat is 6 ft. below top of copings, with a face 4 ft. 6 in. by 25 ft. 4 in. and is at elevation 585.6, but slightly above high water mark. The bridge seat coping is similar to copings on piers and on top of abutments, but is 2 ft. thick. The longitudinal bars in the bridge seat extend ⅔ of the way to the back of the back wall.

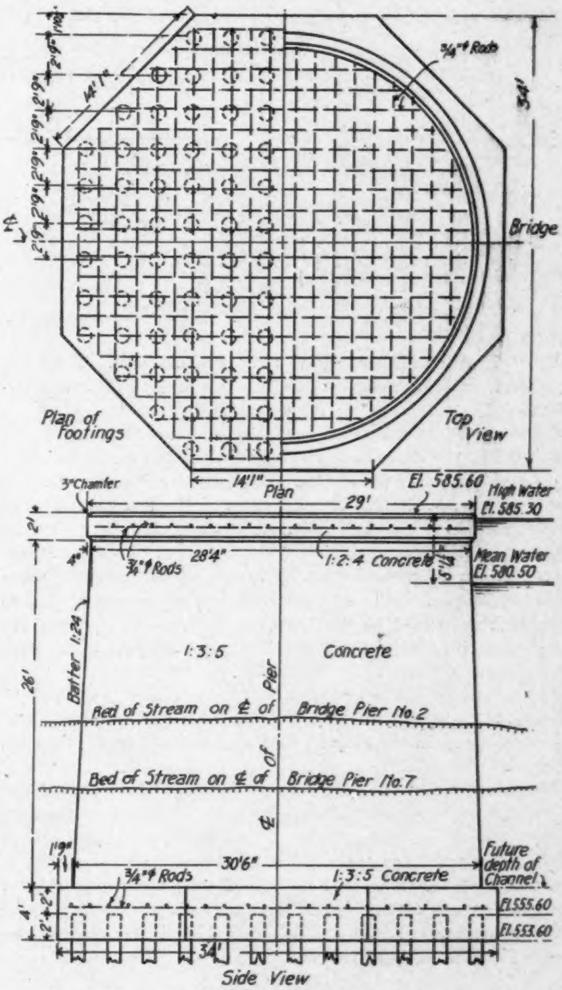
The maximum stress allowed in the concrete was 600 lbs. throughout, disregarding the stress to be taken by the steel reinforcing. The stress in the latter will not exceed 16,000 lbs. under ordinary conditions.

Superstructure.

Designing Loads. The superstructure was designed for the maximum stress which would be caused by either of the three following assumptions: (1) A live load of Cooper's E-50+30%; (2) E-65 at working stress of 20,000 per square inch; (3) E-52 at ordinary working stress. The dead load assumed was 3,000 lbs. per lineal foot, and the impact was figured from the formula

$$\text{Impact} = \frac{L^2}{L+D}$$

wherein L = live load and D = dead load.



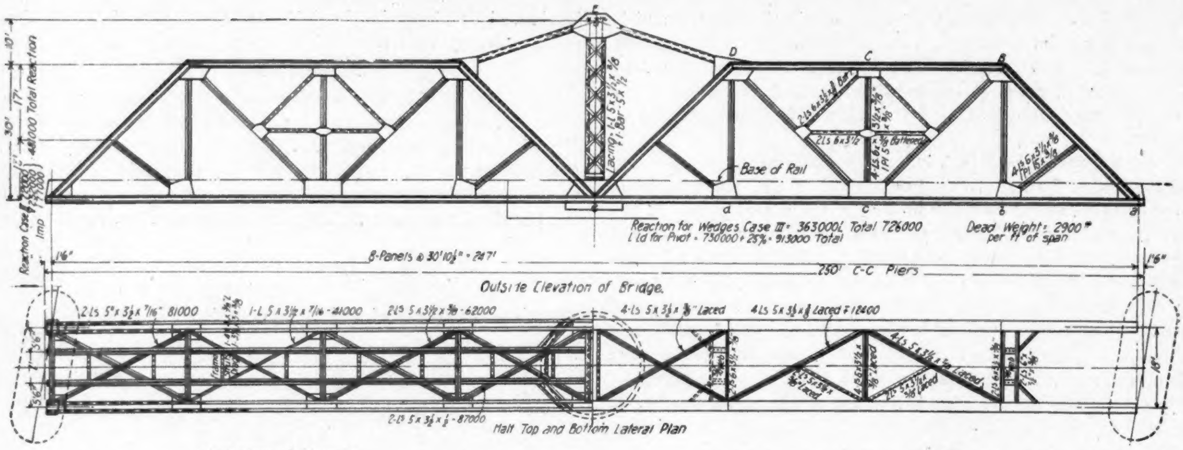
Half Plan and Elevation of Pivot Piers No. 2 and 7.

Since the medium steel is capable of occasionally being stressed to 20,000 lbs. per square inch, the designers are sure that a load up to E-65 can occasionally be put on the bridge without great danger of failure, provided the maintenance is good. This will obviate the necessity for strengthening a few members of the structure to make the whole stand up under slightly heavier loading.

Stresses. The allowable tension in steel was 16,000 lbs. per square inch. The column compression was figured by the formula

$$16{,}000 - 70\frac{l}{r},$$ with a maximum of 14,000 lbs. per square inch.

Direct compression of 16,000 lbs. per square inch was assumed in castings. All structural metal was medium steel, conforming



Combination of Stresses

DL Swinging DL Contin's LL Continus LL Arm LL Sim Spn

Member	Case I	Case II	Case III	Case IV	Case V	Combination	Section
a b c	+ 26000	- 48000	- 189000		- 163000 - 126000 imp	- 337000 II V	2-15" c 40# Cs + 21.02" Net
c-d e	+ 218000	- 4500	11000		- 163000 - 159500 imp	- 327000 II V	2-15" c 45# Cs
B C D	- 99000	+ 50000	+ 113000		+ 214000 + 178000 imp	+ 447000 II V	2-15" c 50# Cs 1 Pl 24" x ½" + 41.4"
D-E	- 302000	- 68000	- 156000			- 378000 I+25%	2-15" c 45# D 26.48" Net
a B	- 36000	+ 67000	+ 153000		+ 227000 + 113000 imp	+ 447000 II-V	2-15" c 50# Cs 1-Pl 24 x ½
D-e	+ 97000	+ 97000	+ 222000		+ 227000 + 159000 imp	+ 483000 I-V	2-15" c 50# Cs 1-Pl 24" x ½"
B-C	+ 182000	- 2500	- 5000		- 109000 + 41000	+ 246000 I-II-V	4 Ls 6 x 3½ x 5/8" 1-Pl 15 x ½
C-D	- 165000	- 62000	- 143000	+ 47000	- 109000 + 41000	- 342000 I-V	4 Ls 6 x 3½ x 5/8" 1-Pl 15 x 5/8"
Bd-Dd	- 30000				- 105000 - 82000 imp	- 217000	4 Ls 6 x 3½ x 5/8 1-Pl 15 x 5/8
E-e	+ 200000	+ 57000	+ 69000 + 51000 imp			+ 326000 I-III	4-Ls 6 x 3½ x 5/8 2-Pls 15" x 5/8"

Plan, Elevation, and Table of Stresses in Swing Span.

to A. R. E. A. specification with some modifications. There are five fixed Pratt truss spans 160 ft. long and two electrically-operated Pratt truss draw spans 250 ft. long.

Trusses. All of the spans are modified Pratt trusses. In the 160-ft. spans the short horizontals and diagonals at the intermediate vertical posts reduce the unsupported column lengths of the diagonals, as do also the diagonals in the end panels. The swing spans have similar short members and also corresponding members on the opposite sides of the verticals. This is because of the higher compression set up in the second diagonal when the span is open. In this member the maximum compression as a simple span would be + 41,000 lbs., but when suspended the stress is + 102,000, while a combination of all possible stresses may produce a stress of + 246,000 lbs.

The clearance in the bridge is 16 ft., the trusses are on 18-ft. centers, the distance out to out being 20 ft. The other clearances are given in the Grand Trunk standard clearance diagram, reproduced herewith.

The floor is the standard section for single track. The ties are 10x10x14 in. spaced 1 ft. 2 in. centers, dapped into the floor girders. Longleaf pine, Georgia pine or Pacific coast red fir only are accepted for these timbers. Guard rails are placed at distance of 9 in. (measured at ball of rail) from gage side of main rails and extend 60 ft. beyond ends of bridge; guard timbers are located with inside edges 5 ft. 5 ins. from center line. Ties are hook bolted to the girders.

General Notes.

The positions of the piers were triangulated from base lines, one on each side of the river. One served as a check on the other.

Considerable difficulty was experienced on account of rafts of logs catching on cofferdams, and floating equipment. Some of these rafts were as much as 4,000 feet long, and the ends would almost invariably hook onto piling or cofferdams.

Construction.

Excavation. The excavation was partially completed by dredges before driving piles. Piles were driven with a drop hammer, and after the cofferdams were driven the excavation was completed by hand, using pumps.

Piles. Piles were driven full length to about cut-off elevation. When dams were unwatered about 1 ft. was sawn off and bark removed. All piles were driven to surface of water and then "followed" down to cut-off. On account of the very soft nature of the bed of river, no difficulty was experienced in driving to about elevation of cut-off. Some excavation was performed at each pier site by a dipper dredge, but in several cases the pits filled up almost immediately. The average penetration on the last five blows of the hammer, for nearly all piles, was ½ in. per blow.

Four piles were first driven at the center of each pier, their tops pulled in (which made them rigid) and a rough platform built to "check" the pier center by triangulation, from which point the positions of other piles were located. Temporary piles were driven to locate framing to start sheet piling.

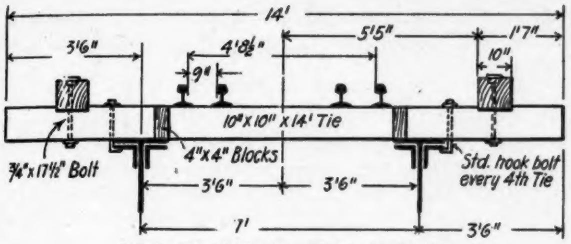
Cofferdams. All sheet piling consisted of 12x12 in. x 40 ft. fir timber, grooved at the mill as shown. Dry 2x4 in. Norway pine was used for "feather" and nailed to piles with 8-in. wire spikes, spaced 24 ins. The sheet piling was later sawn into 2x4 material and sold. Eighty per cent of the sheet piling stood driving three times.

Beyond a depth of 25 ft. the wooden sheeting caused trouble, because of its buoyancy and the softness of the stream bed, and had to be held down by piles. Up to this depth, i. e., where it can be used, wooden sheet piling certainly appears to be cheaper than steel.

Forms. The forms for the rectangular piers were of timber, ordinary type, well braced. Forms for the two circular piers were manufactured in a mill near by. These forms, from top of footing to bottom of coping, consisted of three vertical sections, two of 9 ft. and one of 8 ft. The two lower sections were of hemlock; top sections were entirely of Norway pine. Segments were sawn to the required radius from 3x12 in. x 12 ft. planks, and 2x6 in. dressed was nailed to the faces. The segments were spaced 30 in. center to center (vertically), and arranged so end of each segment would lap on end of segment of next section about 12 ins. After sections were erected, a piece of ¾-in. cable was stretched around the outside and tightened with a small turnbuckle. Two pieces of cable were used to each vertical section. The forms were braced from the walls of the cofferdam. The circle consisted of eight 10-ft. sections and one reserved and cut to form closure in each lift.

Concrete. The aggregates for concrete were loaded on scows and towed to the piers from a dock track about one-half mile downstream. Each scow was loaded with sufficient material for a 100 cu. yd. batch. The mixer was located on the end of the scow, the mixer and forms both being served by a McMyler universal crane. All concrete was placed by 1-yd. bottom dump buckets; chuting concrete was not allowed. Piers were built in 4-ft. lifts, all concrete being placed in the dry.

Washed gravel was used throughout, as the coarse aggregate, the gravel being obtained washed and screened from pits at Mason, Mich. One-man stone were used in the piers. Burt Portland cement was used. No crushed stone was easily available,



Single Track Bridge Floor, G. T. Ry.

and screened gravel cost 40c less per ton. A 1-yd. Austin cube mixer was used. The sub-contractor was required to start work at each end and work toward the center.

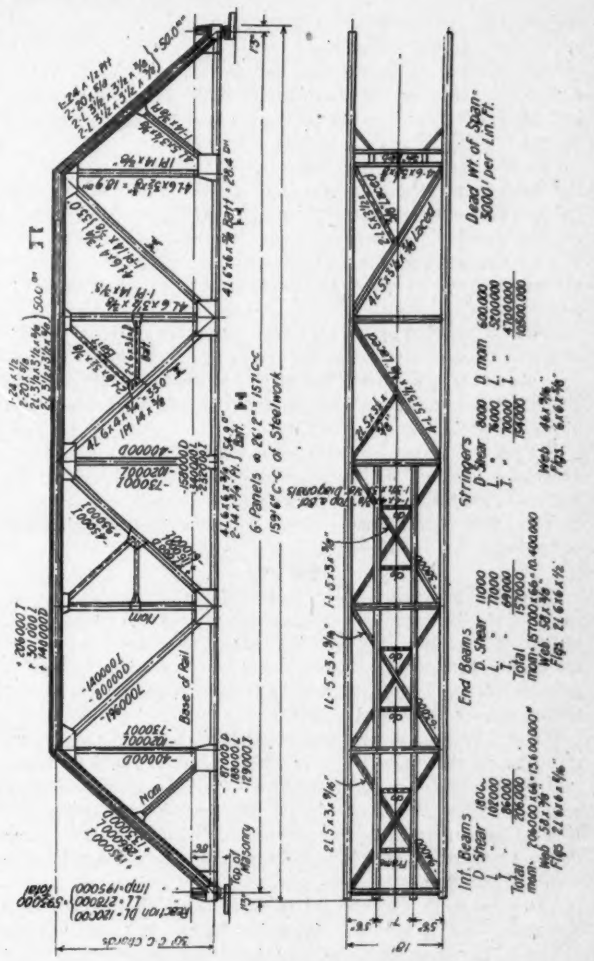
False Work. It was at first proposed to erect false work in the first opening only (between west abutment and pier 1), erect each of the five 160-ft. spans upon it and then move them to their positions on barges or scows. This method was thought to be the most economical, but had to be abandoned on account of being unable to obtain sufficient floating equipment. False work was therefore driven for all spans, and consisted of 60 to 70-ft. piles driven to a firm bearing, with 8x16-in. stringers 28 ft. long.

Erection. All the steel was raised by an Industrial locomotive crane. The delivery track was of necessity situated at the west end of the bridge, since the steel was delivered over the lines of the Grand Trunk Ry. No particular difficulties were experienced in erection, although the work was constantly delayed by the substructure contractor. The actual erection of any span, including falsework, did not exceed 10 days. Erection was begun in October, 1912, and finished in May, 1913, very little time being lost on account of inclement weather.

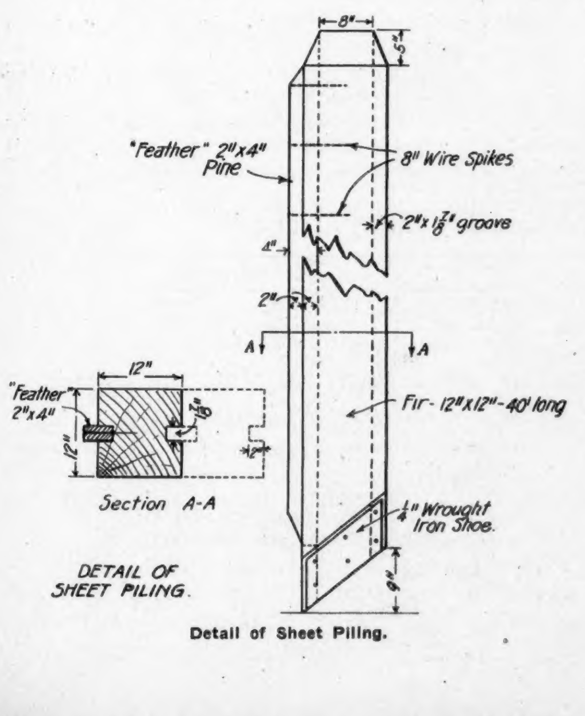
Costs.

Some of the costs given herewith may appear to be low, but they represent actual cost to the contractor, who verified them.

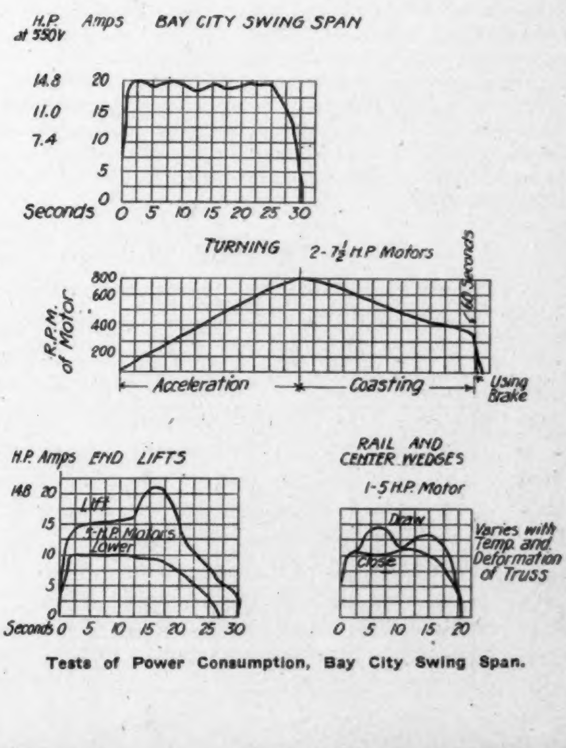
The cost of steel fabricated f. o. b. cars at North Milwaukee, was \$2.20 per lb., the steel being hauled by the site by the G. T. Ry. The cost to the railway for erecting was \$0.62, making the total cost to the company, including falsework, \$2.82, or \$56.40 per net ton, which is low. There were no extra costs on account of the movable spans, except the cost of electrification of the east span. The total weight of steel was 1,500 net tons. The



Stresses in 159 Ft. 6 In. Truss Spans.



Detail of Sheet Piling.



Tests of Power Consumption, Bay City Swing Span.

cost of engineering was about $9,500, or about 5 per cent of the total, including the substructure.

Electrification. The east span is operated by two 7½ H. P. motors for swinging, and with three 5 H. P. motors, one at each end, for raising and locking, and one to operate center and rail wedges.

Only the east swing span is electrified, the swing span across the west channel being operated by hand. The channel is an unimportant one, but a movable span was finally decided upon for the possible future development of that side of the river. The west swing span is a counterpart of the other, and the same electrical machinery could be installed, as provision is made for possible electrification.

Power is supplied by the Bay City Power Co. at 550 D C volts at a cost to the railway company of 2c per K. W. hour. It was only necessary to build 800 feet of line to reach the bridge. The Bay City Power Co. gets its energy from the Au Sable River, about 100 miles north of Bay City.

The small diagram herewith gives the amount of current consumed for opening the bridge, raising the ends and locking the wedges at center and ends. This sketch was made as an average of a number of tests made shortly after the electrification was completed.

Comment.

Considerable trouble was experienced with cofferdams on account of the depth and consequent buoyancy of the timber sheet piling. It was necessary to drive long piles on outside of dams for anchorage, and place heavy stones on top at piers 6, 7 and 8. In spite of this trouble, however, the wooden cofferdams proved to be cheaper than steel piling.

While there was no traffic to contend with, neither was there an adjacent river crossing over which material could be transported, and all structural work had to be carried on from one end of the bridge. This did not materially lengthen the time of construction, as the steel work, which might have been delayed somewhat by this, was constantly delayed by the substructure anyway.

The steel work was erected in remarkably short time—only averaging 10 days to a span, including falsework.

The character of the underlying strata was of such nature that the real engineering design of the foundations had to be made in the field, practically disregarding previous data.

Personnel.

The contract for the substructure was carried out by Wm. J. Meagher & Co., of Bay City, Mich. The steel was fabricated and erected by the Wisconsin Bridge Co., Milwaukee, Wis. The east swing span was electrified by C. H. Norwood, Chicago, Ill.

The steel was designed under the direction of H. B. Stuart, bridge engineer of the Grand Trunk Ry. The substructure was designed by R. D. Garner, who was engineer of construction on the work from its inception, under the supervision of H. R. Safford, chief engineer.

We are indebted to Mr. Safford and Mr. Garner for the data, plans and photographs from which this article was prepared and illustrated.

The International Correspondence Schools have evolved a railway accounting course designed especially to meet the constantly growing demand for men trained for railway office work to care for transportation accounts. The importance of this course is shown by the fact that the single item of transportation forms the largest single item of expense in the whole world. The general railway accounting course is divided under the following heads: (1) Railroad organization and books; (2) Expenditures; (3) Revenue accounts (4 parts); (4) Operating expenses; (5) Income and profit-and-loss accounts. A course is also offered in Railway Agency Accounting, of interest to station and ticket agents and officials, etc.

RAILWAY ENGINEERING APPRENTICES IN SOUTH AFRICA.

Beginning with 1912, the South African Railways has taken into its service a number of students, on the following conditions.

The applicant must be capable of passing an examination which would make him eligible to a student or associate membership of the Institution of Civil Engineers, London. He then is employed as an apprentice for three years, the first 9 months in the drafting room and on preliminary surveys, for which he must be equipped with drawing instruments, level, rod and steel tape. He is then made a junior engineer, and after two years, second assistant engineer, which requires him to provide several additional instruments.

The railway does not agree to continue to employ the engineer when his apprentice term is up, but if he has given satisfaction he is furnished with a statement of the fact signed by the chief engineer. His salary for the first year is $584.00, for the second $770.00 and for the third, $950.00.

These conditions do not compare very favorably with the average of railway engineers in this country. An effort is made, however, to give the students as wide a variety of work as practicable, the practice in this country in many instances, sad to say, being to confine a man to one limited portion of his field.

The Atlantic Coast Line has asked permission to build a bridge across Trout creek, near Jacksonville, Fla.

The Southern will this spring begin the erection of a new and modern passenger depot at Griffin, Ga.

Rapid progress is being made in the preparing for the new terminal station that is to be erected by the Central of Georgia Railway at the foot of Cherry street, Macon, Ga.

Detailed Costs to Contractor, Bay City Bridge

	PILES						EXCAVATION								PUMPING			
Structure	No Pcs.	Lineal Feet	Cost	Cost of Driving	Total	Cost per ft. in place	Cubic Yards	Excavated by Dredge	Cost of Dredge	Excavated by Labor	Cost of Labor	General Charge	Total	Cost per Cu. Yd.	Pump Rented & Elec't Services	Labor	General Charge	Total
West Abutment	64	2010	272.92	177.00	447.92	0.22	340	340	920.90			61.40	982.30	2.89	260.50	72.00	16.50	359.00
East Abutment	95	3515	475.95	123.50	599.45	0.17	343	200	500.00	143	688.82	53.08	1241.90	3.62	376.00	188.00	44.50	608.50
Pier No. 1	65	2313	312.99	178.50	491.49	0.21	480	246	150.00	234	243.90	46.80	440.70	0.92	338.80	63.50	23.40	425.70
Pier No. 3	66	2161	285.60	180.00	465.60	0.21	330			330	596.40	35.54	631.94	1.91	350.00	70.60	25.45	446.05
Pier No. 6	99	2888	380.00	329.50	709.50	0.24	265			265	980.90	23.61	1004.51	3.79	367.20	167.50	39.70	574.40
Pier No. 8	87	3170	415.25	211.50	626.75	0.19	265			265	500.40	24.40	524.80	1.98	362.20	186.50	40.50	589.20
Pivot Pier 2	114	3794	505.39	252.00	757.39	0.20	615			615	1605.40	53.50	1658.90	2.69	395.40	102.50	34.40	532.30
Pivot Pier 7	160	5750	727.25	331.00	1058.75	0.19	439			439	2363.80	43.60	2407.40	5.48	407.00	263.00	54.50	724.50
Pier No. 4	74	2349	311.60	192.00	503.60	0.21	175	175	398.90			12.68	411.58	2.41	347.82	33.17	10.88	391.87
Pier No. 5	86	2252	317.40	210.00	527.40	0.23	130	130	398.90			12.68	411.58	3.16	338.80	25.15	18.90	382.85

Detailed Costs to Contractor, Bay City Bridge

COFFERDAMS

Structure	Sheet Piles			Shores			Driving		Pulling		Labor on Piles	Labor on Shors	General Plant Charge	Credit Materl Sold	Cost of Dams	Size of Dams
	No F.B.M.	Cost M.	Total Cost	No. F.B.M.	Cost M	Total Cost	Per Pile	Per Dam	Per Pile	Per Dam						
West Abutment	25500	10.00	255.00	5000	10.00	50.00	1.50	207.00	0.50	69.00	176.75	145.60	97.00	–	990.25	28'x30'
East Abutment	70560	15.00	1058.40	6078	10.00	60.78	1.50	235.50	0.50	78.50	411.68	358.37	130.80	471.44	1862.59	34'x38'
Pier No. 1	54720	15.00	820.80	3620	10.00	36.20	1.50	171.00	0.50	57.00	164.16	161.75	119.00	365.50	1163.81	40'x16'
Pier No 3	54240	15.00	813.60	5440	10.00	54.40	1.50	169.50	0.50	56.50	162.72	104.15	65.00	362.32	1063.55	16'x40'
Pier No. 6	57600	15.00	864.00	5440	10.00	54.40	1.50	180.00	0.50	60.00	172.80	153.71	117.00	384.75	1217.16	16'x40'
Pier No. 8	58560	15.00	879.00	5440	10.00	54.40	1.50	183.00	0.50	60.00	375.60	462.25	128.00	391.18	1752.28	16'x40'
Pivot Pier 2	67680	15.00	1015.20	10820	10.00	108.20	1.50	211.50	0.50	70.50	403.04	383.50	131.00	452.10	1870.64	35'x35'
Pivot Pier 7	67680	15.00	1015.20	14400	10.00	144.00	1.50	211.50	0.50	70.50	403.04	642.75	134.50	455.68	2180.81	35'x35'
Pier No. 4	20750	10.00	207.50	1810	10.00	18.10	1.50	156.00	0.50	52.00	162.16	125.00	195.00	–	915.53	13'x36'
Pier No. 5	26180	10.00	261.80	1810	10.00	18.10	1.50	156.00	0.50	52.00	178.54	132.00	196.00	–	949.49	13'x36'

-COST OF FORMS-

	West Abutment	East Abutment	Pier No. 1.	Pier No. 3.	Pier No. 6.	Pier No. 8.	Pivot Pier No. 2	Pivot Pier No. 7	Pier No. 4.	Pier No. 5.
Lumber B.F	7400	11800	5300	5300	5300	5300	65.50	6550	3700	3700
Cost per M	5.00	5.00	5.00	5.00	5.00	5.00	12.00	12.00	5.00	5.00
Total Cost	37.00	59.00	26.50	26.50	26.50	26.50	78.60	78.60	18.50	18.50
Labor Erecting	146.50	195.00	92.75	99.20	105.10	106.35	181.36	176.05	59.75	62.50
Labor Removing	24.50	43.00	18.00	19.75	25.00	22.00	39.20	18.80	15.50	14.00
Hardware	8.00	11.50	5.20	5.85	6.90	7.60	-	5.80	5.10	4.70
General Charge	24.99	35.42	16.41	17.49	18.89	19.75	35.40	31.10	11.30	11.51
Total Cost	240.99	343.92	158.86	168.79	182.39	182.20	341.91	300.35	109.65	111.21
Cost per Cu. Yd.	0.67	0.55	0.41	0.43	0.47	0.47	0.40	0.38	0.47	0.47

CONCRETE - MATERIAL & LABOR

Structure	Cement		Gravel		Building Stone		Reinforcing		Coal		Labor Mixing	Tug Hire	General Plant Charge	Yards in Piers	Total Cost	Cost Cubic Yard
	No. Bbls	Total Cost	No. Yards	Total Cost	No. Yards	Total Cost	No Pounds	Total Cost	No. Tons	Total Cost						
West Abutment	421	441.00	452	632.80	None	None	876	26.28	8	24.00	371.00	None	161.90	361	1656.98	4.59
East Abutment	575	605.00	702	1404.00	124	198.50	1450	43.50	40	120.00	1405.25	None	440.00	621	4216.25	6.79
Pier No. 1	400	420.00	485	679.00	104	149.76	1339	40.17	9	27.00	371.90	92.50	182.10	388	1962.43	5.06
Pier No. 3	360	388.50	485	679.00	95	137.80	1339	40.17	9	27.00	661.31	76.00	209.10	388	2218.87	5.71
Pier No. 6	365	383.25	485	679.00	149	214.56	1339	40.17	9	27.00	533.75	102.50	206.00	388	2186.25	5.66
Pier No. 8	360	388.50	485	970.00	92	132.50	1339	40.17	25	75.00	1751.80	None	341.10	388	3705.07	9.55
Pivot Pier No. 2	750	786.45	1072	1500.80	231	332.62	3003	110.11	15	45.00	683.20	110.00	389.00	858	3957.18	4.50
Pivot Pier No. 7	762	850.50	1072	1500.80	214	308.16	3003	110.11	25	75.00	1322.90	210.50	458.00	858	4835.97	5.61
Pier No. 4	289	303.05	295	463.00	84	120.96	1192	35.76	7	21.00	633.50	29.00	139.00	236	1745.27	7.39
Pier No. 5	293	253.05	295	413.00	73	104.40	1192	35.76	7	21.00	315.50	56.00	115.80	236	1314.51	5.57

-SUMMARY-

	West Abutment	East Abutment	Pier No. 1	Pier No. 3	Pier No. 6	Pier No. 8	Pivot Pier No. 2	Pivot Pier No. 7	Pier No. 4	Pier No. 5.
Piles	447.92	599.45	491.49	465.60	709.50	626.75	757.39	1058.75	503.60	527.40
Cofferdams	990.25	1862.67	1163.81	1063.55	1217.16	1752.28	1870.64	2180.81	915.53	949.49
Pumping	359.00	608.50	425.70	446.05	574.40	589.20	532.30	724.50	391.87	382.85
Excavation	982.30	1241.90	440.70	631.94	1004.51	524.80	1658.90	2407.40	411.58	411.58
Forms	240.99	343.92	158.86	168.79	182.39	182.20	341.91	300.35	109.65	111.21
Concrete	1656.98	4216.25	1962.43	2218.87	2186.23	3705.07	3957.18	4835.97	1745.27	1314.51
Fenders							7141.10	9194.61		
Total Cost of each Pier	4677.44	8872.69	5642.99	4994.80	5774.19	7380.30	16259.42	20702.39	4077.50	3697.04

American Wood Preservers' Association

Abstracts of Some Interesting Papers and Reports Submitted at the Annual Convention at New Orleans, La.

SOME METHODS OF SEPARATING WATER FROM CREOSOTE OIL.

Thomas White, Assistant Manager, American Creosote Works.

In the cold condition the contents of a tank of creosote will stratify in the tank into three main horizontal zones, each of varying depth, depending upon the gravity of the oil. The top zone will be free water floating over the middle one, which is an emulsion, while the bottom zone will contain the least amount of water, which we incorrectly say is in chemical combination with the oil. The water in this bottom zone is usually such a small portion, within our lawful allowance, that it will hardly be troublesome. This zone is the most accessible in the tank and very likely will be first used. It is the water in the middle zone which is most difficult to eliminate. Heating the contents to boiling point in an open tank with steam coils will create an upward circulation, which will continue after the steam has been shut off and until the liquid thoroughly cools. Since the water is lightest it will rise to the top, where it can be readily drawn off. If the tank is provided with an agitator it will greatly facilitate the operation, causing quicker evaporation and stratification.

The other method of water extraction, which is the best but not always justifiable at the creosoting plant, is the still method. Ordinarily, the use of the still for this purpose at the treating plant is so seldom required, and this, coupled with its comparatively higher cost of installation and maintenance, makes it rather prohibitive there.

Of course there are numerous other methods of water extraction, such as centrifugal and vacuum processes, some of which might be preferred in individual cases.

REPORT ON PRESERVATIVES.

E. F. Bateman, Chairman.	A. E. Hageboeck,
S. R. Church,	G. H. Davidson,
E. F. Fulks,	L. C. Drefahl,
H. M. Newton,	Committee.

The committee submitted a slightly modified definition of creosote oil, as follows: "Creosote oil, in the scientific sense, may be properly defined as any and all distillate oils boiling between 200 and 400 deg. C., which are obtained by straight distillation from tars consisting principally of compounds belonging to the aromatic series and containing well defined amounts of phenoloids."

A recommendation was made that the association adopt a standard type of thermometer, to be standardized by the Bureau of Standards or some other reputable testing station. The following specifications were submitted for thermometers:

The thermometer shall be of glass, well annealed, and shall not undergo serious changes at the zero point when heated up to 400° C.

The space above the mercury column shall be filled with gas—either carbon dioxide or nitrogen—and the thermometer shall have an expansion chamber at the top.

The scale shall read from 0 to 400° C. in 1° C. graduations which shall be etched on the stem.

The tip of the thermometer shall carry a ring for the purpose of attaching tags.

The thermometer shall have the following dimensions:

Total length, 375 mm.; tolerance, 10 mm.

Bulb length, 14 mm.; tolerance, 1 mm.

Distance from 0 mark to bottom of bulb, 30 mm.; tolerance, 4 mm.

Scale length from 0 to 400° C., 295 mm.; tolerance, 5 mm.
Diameter of stem, 7 mm.; tolerance, 1 mm.
Diameter of bulb, 6 mm.; tolerance, 1 mm.

When standardized the accuracy of such standardization should be as follows:

Up to 200° C..........to the nearest .5° C.
200 to 300° C..........to the nearest 1.0° C.
300 to 360° C..........to the nearest 1.5° C.

The committee submitted, as specifications for creosote oil, the specifications of the American Railway Engineering Association and those of the National Electric Light Association. They recommended "That in future work on the standard methods of analysis of creosote and in the preparation of specifications, the committee be instructed to confer with other similar committees with a view of obtaining uniform standard specifications and methods of testing."

An appendix to this report gives details of methods of testing creosote oil, with a number of diagrams and illustrations.

THE PROTECTION OF TIES FROM MECHANICAL DESTRUCTION.

By Howard F. Weiss, Director, Forest Products Laboratory.

The good results being obtained in protecting ties from decay is placing a large per cent of our ties in the cedar class; i. e., where 75% of them are destroyed by mechanical wear. This means that the problem of mechanical protection is one of increasing importance.

The protection of ties from rail wear is secured by means of tie plates. These serve two primary functions: (1) The protection of the tie from the crushing and pounding action of the rail due to the passage of rolling stock; and (2) the protection of the tie from the grinding action of the rail caused by its tendency to creep and vibrate.

Two general types of plates have been advocated to protect the ties, i. e., wood and metal plates. Wooden plates have not proven satisfactory with American roads, as they frequently work loose, and offer no support to the spike against lateral thrust.

Metal plates have given better satisfaction. They are made in two general types, ridged plates and flat plates. Ridged plates have been found to gouge the wood and leave the untreated exterior of a tie exposed to decay. They offer resistance to lateral thrust, however.

Flat plates sometimes work loose and rattle, and furthermore, they offer no reinforcement to the spike against lateral thrust.

A feature which has perhaps not been given sufficient attention, is the different size plates required on ties of varying hardness. If soft ties are interspersed among hard ones, using the same sized tie plates, the soft ties will fail from mechanical destruction before the hard ties. It is reasonable to assume that the hardness should have an effect in fixing the price of cross ties, those requiring the largest tie plates to sell at the lowest price.

Protection of ties against spike killing or cutting, is important. Cut spikes are cheap and easy to apply. They work loose, however.

Screw spikes have a greater holding power, nearly twice as great, in fact. The use of wooden dowels screwed into the previously bored ties to receive the spikes, is expensive, and the tie is weakened by the large holes. When put to a practical test in well maintained track, the method has been successful.

All hewn ties should be adzed and bored before treating; otherwise untreated wood is exposed and is easily reached by decay. Boring for cut spikes is of direct value, as the fibers are not destroyed, and the holding power is increased.

Conclusions.

(1) The increasing number of treated ties being used in this country is increasing the importance of protecting them from mechanical destruction because the problem of protection from decay is being rapidly solved. To secure best results, therefore,

a protection of treated ties from rail and spike cutting is strongly recommended.

(2) It is believed that, other things being equal, the size of the tie-plate should depend upon the kind of tie with which it is to be used. Soft ties demand larger plates than hard ties. It is felt that this fact should be recognized in fixing upon the price of various timbers for cross ties.

(3) Preservative treatments with creosote and zinc chloride when properly made affect the strength of ties so slightly that any difference in crushing value is of little or no practical importance.

(4) On account of their holding power screw spikes are preferred to cut spikes and can be recommended where high-class construction is desired.

(5) Adzing and boring ties, particularly the adzing of hewn ties, prior to treatment, is considered of prime importance in preparing them for service. Adzing after treatment should be classed bad practice, as it exposes or tends to expose the interior of ties to decay at a point where protection is most needed.

FUTURE TIE MATERIAL IN THE UNITED STATES.

By H. H. Gibson, Editor Hardwood Record.

In round numbers 125,000,000 cross-ties are needed yearly. This is equivalent to 4,000,000,000 board feet, and the ties cost the railroads approximately $15.00 per thousand feet, board measure.

A casual examination of cross-ties statistics will suffice to show that a few woods are furnishing most of the material, although the forests of the United States contain over 500 different species of wood. It might be supposed that when the few woods which now are furnishing the bulk of the ties become scarce, the tie-cutters can simply switch off to some of the 500 other kinds and go on cutting. That would be a simple solution of the problem if it were practicable, but serious obstacles are in the way of doing it. Four out of five of the forest trees of this country, taken as they come, are unfit for any kind of cross-ties, and must be left out of all consideration, both for the present and in the future. They are either too small or too scarce.

White oak and Southern yellow pine, which at present are the chief sources of ties, are being depleted. The process is not so rapid as to call for immediate alarm, but the tendency is unmistakable. Much Northern white cedar remains, but its growth does not half make good the cut, and any increased demand would quickly bear results in lessened supply. In other words, there is not enough of this cedar to last long if tie-cutters should undertake to make good there what they will soon lose in white oak.

As far as absolute scarcity of tie timber is concerned, it will be many a year before railroads are unable to get some kind of ties if they are able and willing to pay the price; but the time is not far off when the manner of providing ties for the country's railroads will need radical revision. The revision has already begun, and its basic principle does not consist so much in searching for new woods as in treating with preservatives the old woods to make them last longer. The salvation of the railroads lies in that direction. Treatment is being applied to woods which decay quickly without it, thereby drawing upon new sources of supply. The reports do not specify, yet it is well known, that most of the nine million and more oak ties which passed through the treating plants were in the red oak or black oak class. These woods in the natural state decay quickly when laid in tracks; but treatment lengthens their life. Nine million red oak ties lessens the drain by that much on the white oaks. Even such woods as gum, beech, elm, white pine, sycamore and hickory make good ties after being passed through the preserving tanks. A practically worthless tie wood in its natural condition is converted into a serviceable piece of timber by the injection of preservatives.

Viewed in that light, the tie situation is not particularly discouraging. Some of the old tried woods are becoming scarce, but dozens of others heretofore hardly used are available with the aid of the treating tank. A practically clean sweep can be made of all trees on a tract, provided they are of suitable size. That will bring ties to the tracks which heretofore were left as an encumbrance on cutover land. Utilization will be closer, waste will be less. It will not be a question of finding new sources of tie material, but of making better use of well-known sources.

The time will doubtless arrive in the United States, as it has already come in France and Germany, when ties will be cut from planted timber; but that time is a good while in the future. A little planting has been done, and is being done, but for many years the railroads must look to natural woodlands for ties.

Some of the species which hold out promise as sources of ties because they grow rapidly, reproduce readily, take preservative treatment easily and have extensive ranges, are loblolly pine in the South and white pine in the North; willow oak in the South and red oak in the North; and the cottonwoods and willow in the South and Middle West. Loblolly pine in particular is remarkably promising because of its wide range, vigorous growth, dense stands, phenomenal reproduction and the value of the wood.

In the far West the tie problem is not serious. The pines and firs already of tie size are sufficient for all needs for many years.

EFFECT OF CONDITIONS OF USE AND EXPOSURE ON TREATMENT OF TIMBER.

E. L. Powell, Vice-President, American Creosote Works.

Unfounded reports of failures of treated timber are frequently spread broadcast and such reports are very detrimental to the business of wood preservation. The greatest damage to the industry, however, is a real failure of treated material.

The treating company is, at the present time, better qualified to get up the specifications than most of the engineers, so it is very necessary that the two work together so that improper specifications are not drawn up.

The amount of preservative required is vitally affected by the kind of soil, wet or dry, climate and mechanical wear to be endured, as well as the character of the timber to be treated.

The treating company should have full information of the conditions to which the treated material is to be subjected. The buyer should then be fully informed of what is required, in writing, so that if failure occurs through insufficient treatment the treating company can be absolved from the blame.

Usually differences between the buyer and the seller can be adjusted without causing friction or hard feeling.

AIR PUMPS VS. HYDRAULIC PUMPS FOR INJECTING PRESERVATIVES INTO WOOD.

By F. J. Angier, Superintendent Timber Preservation, B. & O. R. R.

The idea of employing compressed air for forcing the preservative solution into the wood to be treated was, so far as is known to the writer, first adopted by the C. & N. W. R. R. at its plant at Escanaba, Mich. Here the apparatus is different from that used by the B. & O. R. R., but the principle is practically the same.

The operation is as follows: During vacuum the pressure-measuring-drain (P-M-D) tank is charged with the preservative, the oil entering by gravity through a 10-in. pipe, and requiring about 13 min. to fill. The timber in the retort is subjected to an initial vacuum, and just before releasing the vacuum the preservative is admitted to the retort from the working tank, flowing in under atmospheric pressure. The working tank is then shut off and the P-M-D outlet to the retort is opened and air is pumped into the top of the P-M-D tank by an air compressor. When the required absorption is obtained, the valve is closed and the air pump stopped.

The oil is forced back into the working tank by opening a valve in the 4-in. blow-back pipe, and by opening slightly the valve from the P-M-D tank, which still has an air pressure of 125 to 175 lbs. This pressure forces all the oil back into the working tank from both the retort and the P-M-D tank. A final vacuum is then obtained in the retort to regain the surplus preservative, and the vacuum is also set up in the P-M-D tank by opening the valve in the pipe. When the vacuum has been maintained for a sufficient length of time, air is admitted to the retort and thus forces the solution back into the P-M-D tank, since the pipe connection is in the bottom of the retort. The

reclaimed oil can then be measured and forced into the working tank by pressure.

Advantages of the Air Pump.

Only one tank is required for each retort, that tank serving in the triple capacity of pressure tank, measuring tank and drain tank.

One air pump is ample for three retorts, while one hydraulic pump is required for each retort.

The maintenance of one air pump is much less than three hydraulic pumps, and is decidedly cleaner. The air pump requires less attention, and lessens the cost of packing, lubricants, valves, valve seats, plungers etc.

An air pump is a necessity in plants using hydraulic pumps for blowing back solution unless those plants are equipped with expensive underground receiving tanks. In the latter case an air pump can be dispensed with in lieu of a large oil pump for pumping solution back into the working tank. The underground receiving tank is more expensive in operation than the air pump, and no doubt this is the reason why so few plants are thus equipped.

One air pump can be operated on two or more retorts at the same time without deranging the gauge readings. This is not practicable with hydraulic pumps.

Experience has taught us that it is practically impossible to maintain a steady and constant pressure on a charge of timber with a hydraulic pump, even though it is equipped with relief valves, while with the air pump this is easily accomplished.

The amount of steam required to operate one air pump is not more than would be required to operate three hydraulic pumps, but as the exhaust steam is used for heating purposes, this feature is not so important.

Cost of Air Pump System.

One air pump (capacity 8 cubic feet of compressed air per minute at 175 lbs. gauge pressure	$1,200.00
Three Pressure-Measuring-Drain Tanks	2,000.00
Piping, Valves, etc. (estimated)	400.00
Total cost of air pump system	$3,600.00

Cost of Hydraulic Pump System.

Three hydraulic pumps	$1,000.00
Three measuring tanks	900.00
Two drain tanks	400.00
One low-pressure air pump	500.00
Piping, Valves, etc. (estimated)	600.00
Total cost of hydraulic system	$3,400.00

With hydraulic pumps there is more machinery to care for, more tanks to look after, and more piping and valves to maintain. There is also more work for the engineer, and unless everything is compactly arranged the engineer will require an assistant. With the air pump one man can easily look after the entire operation with greater satisfaction and with better results.

TRAM CARS AND THEIR CONSTRUCTION.*

J. H. Grow, Engineer Wood Preservation, Allis-Chalmers Mfg. Co.

There are two important requirements for the economical operation of a treating plant, as far as tram cars are concerned: (1) a sufficient number of cars; (2) cars of rigid construction.

A load of treated ties, which is frequently placed on the tram by a crane, will weigh 10,000 lbs. If the arms bend, they cause trouble in getting the cars into the retort. Cars are also subjected to rough usage by running down inclines and bumping into each other. The total weight on the arms of cars for treating piling is approximately 20,000 lbs. on each bolster.

The first type of cars had arms of ordinary bar iron. Since then channels, solid tapering bars, angles and two-piece box-shaped arms made of plates have been used. The box section tapering arms give the best satisfaction.

Comparing the different arrangements of wheels and axles shows that they form two distinct types—wheels which are fixed or pressed on the axle, with the axle turning in the axle box, and wheels which are loose on the axle, with axle in a fixed position.

It is the contention of many engineers that the fixed wheel is the proper construction for a tram car, and it is pointed out that this fixed wheel is standard practice for all cars used by the railroad companies. This is very true, and there are good reasons for it, but there is no reason why this should be applied to tram car construction; in fact, it is absolutely wrong, and the wheel on the tram car should be loose and not pressed on the axle. If the wheels are pressed on the axle a good deal of friction is created between the wheels and the track when cars are rounding a curve. The outer wheel has to travel a greater distance than the inner one, and since they are both fixed on the axle, it slides along the rail, producing unnecessary friction. The curves in a timber-treating yard are of small radius, and when the loaded cars pass over these curves the push of the loaded ties, resisted by the friction of the wheels on the track has a tendency to bend the arms of the car. The loose wheel overcomes these difficulties entirely, and if it is fitted with a good roller bearing the friction is reduced to a minimum.

Bails of various types are used, nearly all of them being of round iron and varying in the design of the hinges and fasteners.

Recent designs allow the piling of two ties on the car frame between the wheels, which gives each tram an added capacity of two ties, which amounts to considerable in a large plant.

The fact has been realized, that it has been the object of the various designers to construct a car to meet the operating conditions. Not all of the efforts have been successful, and several of the channel and angle arm cars have given out to a certain extent. The arms of the car give the principal difficulty; they either bend out and must be pulled in occasionally, or they bend over in a longitudinal direction. The longitudinal bending usually occurs where the arms curve up from the frame. There is only one way to overcome this difficulty, and that is to construct an arm with sufficient depth, width and material which will withstand any bending and twisting strain, either in an outward or sidewise direction.

At the present time cars can be bought in the market varying in price from fifty to one hundred dollars, and some of the better piling cars are even higher in price. The fact that the better grade of cars is now bought shows that operating men give serious consideration to the car construction and indicates a strong tendency to eliminate the difficulties and troubles caused by the lighter and cheaper cars.

Good heavy and rigid tram cars, while more expensive in first cost, will no doubt give much better results, will ultimately reduce the cost of handling and will increase the efficiency of the plant.

*This paper is a very complete treatise on the subject of tram cars, containing 36 illustrations. It describes and illustrates 12 different types of tram cars and shows the development of the types now in use. Anyone interested in tram cars will undoubtedly wish the original paper.

METHODS OF KEEPING TIE RECORDS.

By E. T. Howson, Editor, Railway Age Gazette.

The first method of keeping a record of the life of ties was to divide the total number of ties in the track by the number inserted each year, which however gave only general results. Brands and dating nails were next used, and are still being used extensively, records being kept for every tie from reports by the foremen. These reports, however, have been found to be far from correct in some cases, and the varying accuracy obtained has led to the installation of test sections. Inspections, reports, and records on these test sections are carried out by competent and responsible employes whose accuracy can be depended upon.

The Chicago, Burlington & Quincy first installed tie test sec-

tions in 1909.* A number of other railways have recently installed test sections.

Special care should be exercised in test sections to use only No. 1 ties and to use representative conditions.

There are four different methods of marking ties to indicate the date laid, viz: (1) use of notches, position of notch denoting year laid; (2) 3-in. spikes, position denoting year laid; (3) dating nails; (4) branding or stamping the year on the end of the tie.

Summary

Special test sections are to be preferred over the universal dating of all ties or any other method so far developed, as a means of securing accurate information concerning the life of ties.

Test sections should be carefully planned to cover representative conditions, species of wood and kind and extent of treatment. They should be under the personal supervision of an experienced representative of the timber preservation or engineering department.

Where possible, such sections should be laid with new ties continuously, with a sufficient number of each kind of tie to secure a fair test.

For the identification of ties both the dating nail and hammer stamping are satisfactory, each possessing certain advantages.

SOME FACTS I HAVE GATHERED FROM OBSERVATION AND INSPECTION OF EXPERIMENTAL TIES.

By J. H. Waterman, Superintendent Timber Preservation, C., B. & Q. R. R.

Most of our experimental ties were laid in 1909, so that we have had only four years' actual experience with these ties, and you may smile when I tell you that I have reported to our people that in the next ten or fifteen years I will be able to tell them something about the actual results which may be obtained by properly treating ties. However, I am optimistic enough to say, without fear of having to take it back, that many of the ties, a large percentage of the treated ties, will be in track twelve to fifteen years, and I will not be surprised to find some of them giving us longer service than that.

After four years' service in track, not one treated tie, treated with any process, has been taken out on account of decay. There have been a few ties taken out because they were broken and split, but it has been necessary to remove none of the ties because they have rotted.

The untreated ties of the various woods would all have been out to date if it had not been that they were scattered through or laid alternately with treated ties, and the treated ties carry the load and so make it possible for the untreated ties to make a better showing than they really would otherwise make. As it is, over 80 per cent of the untreated ties laid in track in 1909 have been taken out on account of decay.

I presume now some of the gentlemen are anxious for me to tell you which is the better treatment, Burnettizing Process (Zinc Chloride), Card Process, an emulsion of Zinc Chloride and Creosote, and the Straight Creosote. I am sure that there is not a man who knows me personally, but knows that if I knew which treatment was the best that I would not hesitate in stating the fact; but from four years' service, or rather four years' observation, it is impossible to draw positive conclusions. There are many things to take into consideration.

The treatment we want to use is the treatment that will preserve the ties so that we can get the mechanical life out of them; and the money we spend for treating ties that will preserve the wood from decay longer than the timber will mechanically wear, is money thrown away.

In 1900 we laid 550 ties out of face near Mystic, S. D., on a 3 per cent grade and a 12 deg. curve. In 1913 all of these were in track except 21, three taken out for laboratory service, 18 for rot. These were red oak treated with zinc chloride. At least 80 per cent of them will give us 15 years' service. The climate is dry and favors zinc chloride treatment.

Fourteen miles of track between Sidney, Neb., and Petz, Colo., were laid with pine ties treated with ½ lb. zinc chloride in 1900, and 95 per cent were still in service September 2, 1913. This is a dry climate, and I believe that for a dry climate, ties which can be treated with zinc chloride for 10 cents or less per tie will surely give satisfaction.

November 15, 1903, to February 5, 1904, we laid 10 miles between Concord and Jacksonville with zinc-treated red oak ties. Sixty per cent are still in use, though they were laid in the winter on a frozen grade, and many were broken and others have worn out mechanically because they were not plated when laid. Now all our treated ties are plated when laid. The reason the C. B. & Q. R. R. has obtained such good results with zinc chloride is because the ties are treated properly and thoroughly.

Conclusions.

From the above you would be inclined to draw the conclusion that I was personally favoring the treatment of ties with Zinc Chloride. I want to state that that is not the intent of this paper; but I am showing you some actual facts that have been accomplished and what we can expect if ties are treated properly with Zinc Chloride.

I have called your attention to the ties treated in the extreme West, where we are getting from twelve to fifteen years' service out of them. I have also called your attention to ties treated in the Middle West, between Concord and Jacksonville, Illinois, which is considered a trying climate, at least on ties, and what we have gotten out of ties properly treated with Zinc Chloride.

If the emulsion of straight creosote full cell process or the empty cell process will give us better service than I have shown above, I will certainly report it to this Association when I have gathered the facts.

I am here to state, and I believe it should be published broadcast throughout this country, that it is a crime to use inferior woods without treatment of some kind. Anything is better than no treatment.

We talk about conserving our forests. We spent sixty years in growing a tie tree and we put it in the track and it decays in three years, and no one says anything about it, when, if it was properly treated, it would give twelve to twenty years' service.

A few months ago it was my privilege to take a trip in the extreme West, and I rode over one of our great trunk lines, where I got reliable information as to the results they were getting from untreated ties placed in track. Few of the ties gave over four years' service, and at the end of five years all of them were taken out. This was on one hundred miles or more of new track which was built five years ago, 1908, and to date they are renewing every tie which had not been renewed prior to 1913.

PRELIMINARY WORK IN FIREPROOFING WOOD.

Robert E. Prince, Forest Products Laboratory.

The combustion of wood may be divided into two parts:

First. The driving off of the volatile gases by heat, and their ignition causing flame.

Second. The combustion of the nonvolatile portions, analogous to charcoal, causing glow or incandescence, and the production of carbon monoxide which is a combustible gas.

It will readily be seen that the first part of the combustion is the most dangerous. The chief problem, therefore, is to render the volatile gases noninflammable.

It has been found that the chemicals most efficient in rendering wood noninflammable are those that sublime or decompose upon being subjected to intense heat. Non combustible gases are given off in both cases, which, when mixed with the inflammable gases arising from heated wood, render them noninflammable.

The chemicals selected for the first experiments were divided into these two classes:

*A description and diagram completely explaining the methods used in these sections appears in *Railway Engineering*, on page 490, November, 1911.

1. Chemicals that "sublime" when subjected to intense heat whose vapors are not inflammable.

a. Ammonium sulphate.

b. Ammonium chloride.

2. Chemicals that decompose when subjected to intense heat, giving off noninflammable gases:

a. Ammonium phosphate.

b. Sodium bicarbonate, noninflammable gas carbon dioxide.

c. Oxalic acid, inflammable gas carbon dioxide.

A method used in previous fireproofing work has been to inject chemicals containing large amounts of water of crystallization, the theory being that the water is converted into steam which creates a noninflammable atmosphere without the wood. Under this method borax and alum water were used. Borax also has the advantage of being a fusible salt, thereby protecting the wood fiber with a glossy coating.

The manufacture of fire-retarding paints also offers a very attractive field of work and was, therefore, included in our tests.

In order to determine the most practicable method of fireproofing wood from the standpoint of efficiency of the treatment it is necessary to determine:

1. The efficiency of the treatment in retarding combustion.

2. The minimum amount of a preservative necessary to accomplish the desired results.

3. The corrosive action of the salt used upon the plant equipment.

4. The effect of the treatment upon the strength of the wood.

5. The effect of the treatment upon the painting and finishing qualities of the wood.

6. The corrosive effect of the treatment upon metal coming in contact with the wood, such as nails, screws, hinges, etc.

Results.

1. Of eight species of untreated wood, tamarack is the most fire-resistant, and redwood comes next.

2. Ammonium salts are of considerable value in fireproofing wood. It was impossible to ignite wood, under our conditions of test, that had been treated with these salts.

3. Borax is of considerable value in fireproofing wood. It has not the value of the ammonium salts, but promises a means of lessening the cost of treating by using it with another salt of greater value.

4. From the good results already obtained it appears possible to devise a reasonably inexpensive method of rendering wood fire-retarding.

MECHANICAL HANDLING OF TIES AND TIMBERS AT TREATING PLANTS.

Lambert T. Ericson, Asst. Supt. Port Reading Creosoting Plant.

The Port Reading plant is located on Staten Island Sound, and most all the timber comes in on schooners. Twenty-five special flat cars are used to transfer timbers from the vessels to the yard, these cars being sufficient to serve five vessels at a time.

The plant uses four locomotive cranes, two 30-ton, one 20-ton and one of 10-ton capacity. The two 30-ton cranes usually handle the ties and switch timber.

Ties are handled in slings of 30 to 60, depending on the height of the piles and the capacity of the crane doing the work. The slings are leveled off on the stacks, by hand, at a piece work rate.

Large dimension timbers are usually handled by the 10-ton crane. The 20-ton crane transfers treated timber from trams into open gondolas, there being a plentiful supply of this type of cars available. Each 30-ton crane shift and stack about 3,500 to 4,000 ties per day.

Approximate Costs.

Stacking cross-ties (including shifting cars to stacks), each	$0.008
Switch timbers, per M. ft. B. M.	0.35
Loading treated ties, per tie	0.0045

EFFECT OF VARYING PRELIMINARY PRESSURE UPON THE ABSORPTION AND PENETRATION OF CREOSOTE IN CROSS-TIES.

Clyde H. Teesdale, Forest Products Laboratory.

The results presented in this paper consist of one group of experiments, the object of which was to obtain data on the following points:

1. The effect of varying the air pressure applied prior to impregnation with creosote upon the following features of treatment:

a. The rate and amount of absorption during the filling and pressure period.

b. The amount of recovery during release of pressure (kick-back).

c. The amount of recovery due to drip and a final vacuum.

d. The uniformity of treatment, indicated by the variation in absorption of individual ties from the average of the charge.

e. The diffusion of preservative through the wood.

2. The transmission of air pressure, vacuum and oil pressure in the wood.

Conclusions.

The following are brief statements of the results indicated by the experiments on red oak, maple, hemlock, and loblolly pine ties:

1. The absorption of preservative during the filling and heating period (initial absorption) was least when no preliminary vacuum or air pressure was used, and greatest when high preliminary air pressures were used. The time required to fill the cylinder varied from about 23 minutes, when preliminary vacuum was used, to about 40 minutes, when a preliminary air pressure of 75 pounds was used. Loblolly pine was an exception.

2. Preliminary air pressures did not materially increase the time of the oil pressure period necessary to secure the required absorption in maple, loblolly pine, or red oak. In hemlock high pressures materially increased the time of treatment.

3. Loblolly pine required the shortest pressure period to reach the desired absorption. Maple ranked next in order, then red oak. Hemlock required, comparatively, a very long pressure period.

4. The smallest kick-backs were obtained when a preliminary vacuum was used; the highest when high preliminary air pressures were applied.

5. Final vacuum as applied in these tests had no marked influence on the amount of drip recovered, except in the case of loblolly pine. It, however, hastens recovery and enables oil to be saved that would otherwise drip on the ground. In either case the amount finally left in the ties in the majority of cases was nearly the same. The use of final vacuum renders the timber cleaner to handle. Final vacuum resulted in a heavy recovery from seasoned loblolly pine when preliminary vacuum and preliminary atmospheric pressure were used.

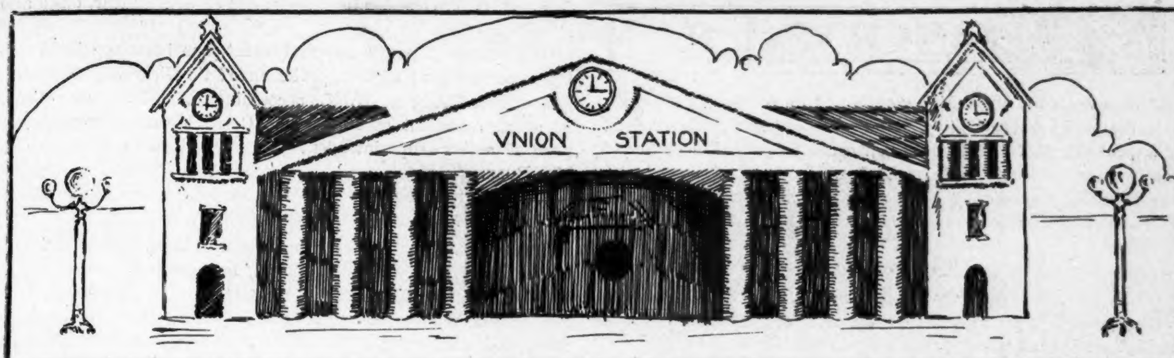
6. The distribution of preservative through the wood was apparently not influenced by preliminary vacuum or air pressure.

ELECTION OF OFFICERS.

The election of officers was held on Thursday, with the following results: President, Geo. E. Rex; first vice-president, Carl G. Crawford; second vice-president, R. S. Manley; third vice-president, F. B. Ridgway; secretary-treasurer, F. J. Angier. The next meeting of the association will be held in Chicago.

The Atlantic Coast Line, it is said, will make improvements and erect additional shop buildings at Waycross, Ga.

The citizens of Rosenberg, Tex., are circulating a petition for a new freight and passenger depot in Rosenberg, both the Santa Fe and the Southern Pacific being asked to appropriate for the construction.



THE BUILDER

BY EDWARD R. FORD.

Now this is the creed of the builder
And the law of the building clan:
That the builder is ever a builder first—
The builder above the man.

For him that is true to his calling,
And for him that hath truly heard,
The need of the flesh is the lesser thing
And the need of the craft preferred.

'Tis the largest hope of the craftsman
For the image his brain designed,
That the thing itself shall bespeak his art
And his art bespeak his mind.

But never conceit of the builder
Can be wrought to the thing he saw,
And never a triumph may come to him
Except by the builder's law.

And the builder's joy of his labor
Is to see in the primal stone
What none but the eye of the builder sees
'Till the builder's work is done.

But never the eye of the builder
Shall answer the builder's need,
Except by the law of the building clan,
Except by the builder's creed.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

Operating

C. H. Bristol, formerly superintendent, has been appointed acting general superintendent of the *Atchison, Topeka & Santa Fe Ry.*, at Pueblo, Colo., succeeding J. M. Kurn, resigned.

J. M. Davis, formerly general superintendent of the Southern Pacific Co., has been appointed assistant general manager of the *Baltimore & Ohio South Western R. R.*, office at Cincinnati, O.

V. A. Harshaw, superintendent of the *Canadian Pacific Ry.*, at Woodstock, N. B., has been appointed superintendent at Brownville Jct., Me., succeeding W. A. Cowan. A. Williams has been appointed superintendent at Woodstock, N. B., succeeding Mr. Harshaw.

J. W. Meredith, formerly superintendent, has been appointed general superintendent of the *Central R. R. of New Jersey*, office at New York, succeeding C. W. Huntington. S. B. Zartman succeeds Mr. Meredith as superintendent at East Long Branch, N. J. C. H. Stein, formerly engineer maintenance of way, has been appointed superintendent at Jersey City, N. J.

George E. Dunklee has been appointed general superintendent of the *Central R. R. of Oregon*, office at Union, Ore.

S. S. Russell has been appointed superintendent of the *Central Vermont Ry.*, at St. Albans, Vt., succeeding J. F. Keefe.

T. H. Bacon has been appointed general manager of the third district of the *Chicago, Rock Island & Pacific Ry.*, as previously announced in RAILWAY ENGINEERING. He commenced railway work in 1886 as station helper, at the age of 16 years, and held successively the positions of ticket clerk, express messenger, baggage man, passenger brakeman, passenger conductor, yard master, general yard master, and trainmaster. He entered the service of the C. R. I. & P. Ry. in the latter capacity in 1902, and has held the positions of superintendent, general superintendent, assistant general manager, and general manager. Mr. Beacon is also president of the *Chicago, Rock Island & Gulf Ry.*

J. F. Manning has been appointed president and general manager of the *Crystal River & San Juan Ry.*, office at Marble, Colo. G. B. Taylor has been appointed superintendent, office also at Marble, Colo.

C. E. Burr, formerly superintendent, has been appointed acting superintendent of transportation of the *Delaware & Hudson Co.*, office at Albany, N. Y., succeeding C. E. McKim on leave of absence account of ill health. C. A. Morgan has been appointed acting superintendent at Carbondale, Pa., succeeding Mr. Burr.

A. H. Elfner has been appointed superintendent of the *Elk & Little Kanawha R. R.*, office at Gassaway, W. Va.

Robert Stephens Parsons has been appointed general manager of the *Erie R. R.*, at Cleveland, O., as previously announced in RAILWAY ENGINEERING. He was born at Hoboken, N. J., and graduated from Rutger's College as a bachelor of science in 1895, and received the degree of civil engineer in 1898. He entered the service of the Erie R. R. as rodman in 1895, and was appointed assistant engineer in 1896. He was appointed division engineer of the N. Y. & W. R. R. in 1899, and engineer maintenance of way of the Erie R. R. in 1903. In 1906 he was appointed assistant general superintendent, and in 1907, superintendent of the Susquehanna division, and was transferred to the New York division as superintendent in 1910. He was appointed assistant general manager in 1913, his appointment as general manager being effective January 1, 1914. He was admitted to membership in the American Society of Civil Engineers in 1900.

JAMES BURKE, Superintendent
Erie R. R.

JOHN HOWARD PEYTON, General Manager
Nashville, Chattanooga & St. Louis Ry.

F. B. Lincoln has been appointed general superintendent of the *Erie R. R.*, Erie division, office at 50 Church St., New York City, as previously announced in RAILWAY ENGINEERING. He was born in New York City, October 9, 1867, educated in the public schools of New York and Connecticut, and graduated from New York University. He entered the service of the Erie R. R. in 1887 as rodman and advanced to transitman and resident engineer, and in 1892 to assistant engineer, Susquehanna division. In 1895 he was appointed trainmaster, in 1898 was appointed agent, and later, in 1898, he accepted a position as superintendent of the Blossburg Coal Co. He was appointed general manager of the Buffalo & Susquehanna Coal & Coke Co., in 1902, and in 1903 was appointed special agent to the vice-president and general manager of the Erie R. R. In 1904 he was appointed superintendent of the Susquehanna division, Delaware & Hudson Co., and in 1905 was appointed superintendent of construction. He resigned and entered the service of the O'Rourke Engineering Construction Co. as superintendent of construction on Grand Central Terminal work. In 1906 he was appointed assistant to receiver of the Pittsburgh, Shawmut & Northern R. R., and Jan. 1, 1914, he

was appointed general superintendent of the Erie division, Erie R. R.

JAMES BURKE, formerly superintendent of roadway, has been appointed superintendent of the *Erie R. R.*, at Chicago, Ill.

W. H. ANDREWS, formerly superintendent, has been appointed general manager of the *Georgetown & Western R. R.*, office at Georgetown, S. C. J. A. EMMART has been appointed superintendent, office also at Georgetown, S. C.

J. RUSSELL, formerly superintendent of the Spokane, Portland & Seattle Ry., has been appointed general superintendent of the *Great Northern Ry.*, at Seattle Wash., succeeding W. D. SCOTT. W. D. MASON, formerly trainmaster, has been appointed acting superintendent at Melrose, Minn., succeeding J. LINDSAY, granted leave of absence on account of illness.

F. HARTENSTEIN has been appointed assistant general manager of the *Lehigh Valley R. R.*, office at South Bethlehem, Pa.

J. W. BUTTS, formerly trainmaster, has been appointed superintendent of the *Missouri, Kansas & Texas System*, at Greenville, Tex.

A. E. POTTER has been appointed president and general manager of the *Narragansett Pier R. R.*, office at Providence, R. I.

vantages were limited. He spent five years at Roanoke College, Salem, Va., taking the ordinary academic training, but never had technical engineering training. In 1881, when 17 years of age, he secured a position as a rodman on a corps of engineers under

J. HOWARD PEYTON has been appointed general manager of the *Nashville, Chattanooga & St. Louis Ry.*, office at Nashville, Tenn. His family is of English descent. During his boyhood his father was in very reduced circumstances, hence his educational ad-

Gen. Gabriel C. Wharton, an old ex-confederate general, and since that time has devoted his time almost exclusively to engineering work. In 1897 he had an office in Charleston, W. Va., and was doing general engineering and contracting work. When war was declared with Spain he closed up his office and took service in one of the volunteer regiments of engineers as a private. A few months later he was sent on a commission to the Philippine Islands by the bishops of the American Episcopal Church to secure information about the moral and religious conditions of our new possessions in the far East. In 1902 he entered the service of the Louisville & Nashville R. R., as a locating engineer, and has been with that company almost continually since that date. In 1904 he was appointed principal locating engineer of the company. In 1907 he published the first edition of "The American Transportation Problem," dealing with a comparison between transportation facilities afforded by inland waterways and modern railroads. A second edition of this book was issued in the fall of 1909. In 1910 he became assistant to president of the Louisville & Nashville R. R., and in 1912, assistant to president and chief engineer of construction of that company. His appointment as general manager of the Nashville, Chattanooga & St. Louis Ry. was effective January 1.

W. S. PALMER has been appointed president and general manager of the *Northwestern Pacific R. R.*, office at San Francisco, Cal. L. R. GLADDEN has been appointed superintendent, office at Albion, Cal.

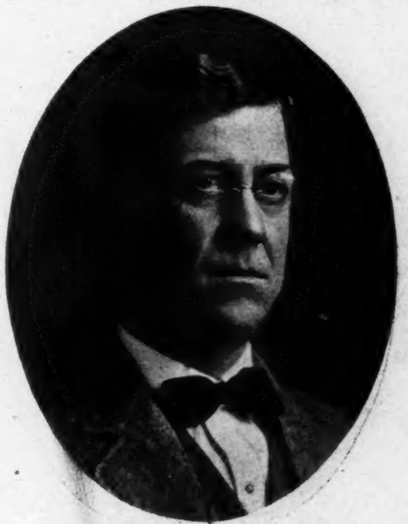
W. B. DENHAM, formerly general superintendent, has been appointed general manager of the *Ocala Northern R. R.*, office at Ocala, Fla.

F. H. KNICKERBOCKER has been appointed assistant to vice-president and general manager of the *Oregon Short Line R. R.*, office at Salt Lake City, Utah.

W. D. SCOTT has been appointed general superintendent of the *Oregon Trunk Ry.*, succeeding J. J. RUSSELL.

M. S. HUTCHINS has been appointed general manager of the *Parral & Durango R. R.*, office at Parral, Mex. GEO. HUTCHINS has been appointed superintendent, office also at Parral, Mex.

G. LE BOUTILLIER, Superintendent
Pennsylvania Lines West.



W. E. DUDENBOSTEL, Superintendent
St. Louis & O'Fallon Ry.

W. B. DOWNING, formerly superintendent, has been appointed general superintendent of the *Pennsylvania Lines West*, office at Toledo, O., succeeding T. B. Hamilton, promoted. G. LE BOUTILLIER, formerly division engineer, has been appointed superintendent at Richmond, Ind. He succeeds J. C. MCCULLOUGH, appointed superintendent at Pittsburgh, Pa., in place of W. C. Downing, promoted.

B. C. MULHERN, formerly superintendent, has been appointed general superintendent of the *Pittsburgh, Shawmut & Northern R. R.*, office at St. Marys, Pa. J. D. BEAVER, formerly assistant superintendent, has been apointed superintendent, office also at St. Marys, Pa.

W. E. DUDENBOSTEL has been re-appointed superintendent of the *St. Louis & O'Fallon Ry.*, office at East St. Louis, Ill. He had been superintendent for five years under the former ownership.

W. D. SCOTT, formerly general superintendent of the Great Northern Ry., has been appointed general manager of the *Spokane, Portland & Seattle Ry.*, office at Portland, Ore., succeeding J. Russell.

G. A. BRADLEY has been appointed superintendent of the *Raleigh, Charlotte & Southern Ry.*, office at Raleigh, N. C., succeeding L. A. BOYD.

GEORGE F. MOORE has been elected president and general manager of the *St. Louis & O'Fallon Ry.*, with office in South Side Bank Building, St. Louis, Mo., as previously announced. He was born Feb. 22, 1862, at Bloomington, Ind. In 1884, just after graduating from the Indiana State University, he began railway

work as assistant cashier of the local freight office of the Louisville, New Albany & Chicago Ry., now a part of the Chicago, Indianapolis & Louisville Ry., at Chicago. In 1890 he was made agent for the Louisville Southern, now a part of the Southern Ry, and in 1894 was appointed freight agent in charge of terminals of the Chicago & Alton Ry., at Peoria, Ill., and in 1900 was made chief traveling auditor of the same road. During the year 1900 he was also connected with the North Shore Dispatch, a fast freight line operated from Chicago in the interest of the Michigan Central R. R. In 1904 he was appointed auditor of the Parral & Durango, and in 1906 he was made auditor, traffic manager and superintendent of the Boyne City, Gaylord & Alpena R. R. In 1907 he was appointed general manager of the St. Joseph Valley. In 1908 he was appointed examiner of the Interstate Commerce Commission at Washington, D. C. He is also president of the Manufacturer's Ry., of St. Louis.

H. G. FARRAR has been appointed superintendent of the *Southern Ry.* at Williamson, Ga., succeeding W. J. Bell.

W. H. DEFRANCE has been appointed superintendent of the *Texas & Pacific Ry.*, at New Orleans, La., succeeding N. G. Pearsall, assigned to other duties.

THOS. OLIVER has been appointed superintendent of the *West Virginia & Southern R. R.*, office at Marmet, W. Va.

Engineering

The office of L. J. ALLEN, valuation engineer of the *Ann Arbor R. R.*, has been moved from Owosso to Ann Arbor, Mich.

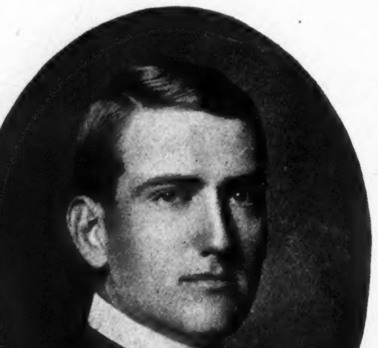
E. M. DURHAM, JR., formerly assistant chief engineer of the Southern Ry., has been appointed special engineer of the *Atlanta, Birmingham & Atlantic Ry.*, office at Atlanta, Ga.

C. B. JUDD has been appointed chief engineer of the *Atlantic Southern Ry.*, office at Atlantic, Ia.

R. S. WELCH has been appointed assistant engineer of the *Baltimore & Ohio South Western R. R.*, at Cincinnati, O., succeeding F. J. PARRISH, transferred.

J. J. ROURKE has been appointed assistant engineer of the *Boston & Maine R. R.*, at Boston, Mass.

J. ROBERTSON has been appointed assistant division engineer of the *Canadian Pacific Ry.*, at Moose Jaw, Sask. He succeeds H. B. SIMS, who has been appointed assistant division engineer at Vancouver, B. C., succeeding H. B. WALKER, appointed resident engineer at Nelson, B. C. MR. WALKER succeeds E. B. SKEELS.



E. M. DURHAM, JR., Special Engineer Atlanta, Birmingham & Atlantic Ry.

J. BEAUMONT, Senior Signal Engineer U. S. Valuation Board, Central District.

T. B. HAMILTON, formerly general superintendent Pennsylvania Lines West, has been appointed general manager of the *Vandalia R. R.*, offices at St. Louis, Mo., succeeding A. M. Schoyer, promoted.

GEORGE F. TURLEY has been appointed general manager of the *Virginia-Carolina Ry.*, office at Abingdon, Va. He was born at Oakland, Md., Dec. 20, 1867, and educated in public schools at Hagerstown, Md. From 1882-1885 he was messenger and clerk, traffic department, Shenandoah Valley R. R. (now Shenandoah Division of Norfolk & Western Ry.); 1887-1889 he was clerk and telegraph operater, Hagerstown, Md., joint service Cumberland Valley & Shenandoah Valley R. R. He held consecutively the following positions: 1889-1898, operator, chief clerk to trainmaster, dispatcher and chief dispatcher, Shenandoah division, N. & W. Ry., Shenandoah, Va.; 1898-1902, dispatcher and chief dispatcher, Shenandoah division, N. & W. Ry., Roanoke, Va.; 1902-1905, assistant trainmaster, Pocahontas division, N. & W. Ry., Bluefield and Williamson, W. Va.; 1905-1912, trainmaster, Shenandoah division, N. & W. Ry., Roanoke, Va.; 1912-1913, trainmaster, Scioto division, N. & W. Ry., Portsmouth, Ohio. Dec. 15, 1913 he was appointed general manager of the Virginia-Carolina Ry. and New River, Holston & Western R. R., with supervision over all departments, headquarters at Abingdon, Va. Both lines are subsidiaries of the N. & W. Ry., in process of extension into timber and mineral countries.

R. V. REAMER, formerly assistant supervisor, has been appointed engineer maintenance of way of the *Central R. R. of New Jersey*, office at Jersey City, N. J., succeeding C. H. Stein, promoted.

H. H. DECKER, engineer maintenance of way of the *Chicago & North Western Ry.*, has resigned to enter a contracting business. D. Rounseville, formerly resident engineer, has been appointed engineer maintenance of way.

G. H. BREMNER, district engineer of the *Chicago, Burlington & Quincy R. R.*, has resigned to go with the U. S. Valuation Board, third district, headquarters at Chicago. R. W. WILLIS, formerly district engineer at St. Louis, has been appointed engineer at Chicago. F. M. PATTERSON, formerly assistant district engineer, has been promoted to engineer at St. Louis, succeeding MR. WILLIS.

H. P. PADLEY, formerly assistant engineer, has been appointed principal assistant engineer of the *Chicago, St. Paul, Minneapolis & Omaha Ry.*, office at St. Paul, Minn.

F. J. PARRISH has been appointed division engineer of the *Cincinnati, Hamilton & Dayton Ry.*, at Dayton, O. He completed a common school education at Richmond, Va., and attended Earlham College, same city. He entered the service of the engineering department of Richmond in 1887, and went with the B. & O. S.-W. R. R. in 1899 as rodman, after having served for a number of years on construction, C. T. H. & S. W. R. R., and on numerous private engineering projects. He was transferred to the real

estate department of the B. & O. S. W. R. R. in March, 1902, as assistant engineer in charge of the survey of lines west of Cincinnati, and was made assistant engineer of the Ohio division of the same railroad in March, 1905, being transferred to the same position on the Illinois division in the spring of 1906, and serving in this capacity until appointed engineer maintenance of way of the K. & I. Ry., Louisville, Ky., in January, 1910. On January, 1913, was appointed first assistant engineer maintenance of way of the B. & O. S. W. and the C. H. & D. Ry., at Cincinnati, Ohio, serving in this capacity until January, 1914, the date of his appointment as division engineer of the C. H. & D. Ry.

N. L. ARBUCKLE, formerly at Wabash, Ind., has been appointed engineer maintenance of way of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.*, at Mt. Carmel, Ill. C. F. HINCHMAN has been appointed assistant engineer maintenance of way at Indianapolis, Ind. A. L. JOHNSTONE has been appointed assistant engineer maintenance of way at Wabash, Ind. H. E. WOODBURN, formerly at Mt. Carmel, has been appointed assistant engineer maintenance of way at Galion, O.

J. A. GRIFFIN has been appointed engineer maintenance of way and structures of the *Georgia Southern & Florida Ry.*, office at Macon, Ga.

D. W. SMITH, formerly assistant engineer, has been appointed valuation engineer of the *Hocking Valley Ry.*, office at Columbus, O.

H. C. WILLIAMS, formerly assistant chief engineer of construction, has been apointed chief engineer of construction of the *Louisville & Nashville R. R.*, office at Louisville, Ky., succeeding JOHN H. PEYTON. J. A. GALVIN has been appointed architect, office at Louisville, Ky. GEO. K. MCCORMICK, formerly roadmaster, has been appointed assistant engineer at Middlesborough, Ky., succeeding A. B. Gloster.

C. A. GATES has been appointed chief engineer of the *Macon, Dublin & Savannah R. R.*, office at Macon, Ga.

H. DE W. SMITH has been appointed chief engineer of the *Missouri, Oklahoma & Gulf Ry.*, office at Muskogee, Okla., succeeding J. J. Harrison.

P. V. SHERMAN, assistant engineer of the *Missouri Pacific Ry.*, has been transferred from Kansas City, Mo., to Falls City, Neb. E. SULLIVAN has been appointed assistant engineer at Kansas City, Mo.

H. D. JOUETT has been appointed designing engineer of West Side improvements, *New York Central & Hudson River R. R.*, office at New York City. He graduated from the Massachusetts Institute of Technology in 1900 and has been employed by the New York Central since that time, in various engineering positions, both in the maintenance of way and construction departments.

The jurisdiction of H. S. OSBORNE, division engineer of the *Oregon Short Line R. R.*, has been extended over the entire Idaho division, office at Pocatello, Ida., succeeding G. H. Cumberland, resigned. H. J. HARRIS and H. A. ROBERTS, both at Pocatello, Ida., have had their titles changed from assistant superintendent to division engineer.

W. W. MORRISON has been appointed engineer maintenance of way of the *Pittsburgh & Shawmut R. R.*, office at Kittanning, Pa., succeeding W. W. Henshey.

T. E. BLISS has been appointed assistant engineer of the *St. Louis & San Francisco R. R.*, at Chaffee, Mo., succeeding F. W. Dunn, resigned to engage in a contract for dredging ditches on the Little River Drainage District.

F. V. MARSHALL has been appointed assistant engineer of the *Wabash R. R.*, at Decatur, Ill., succeeding Edw. Shelah.

J. CLYDE LEWIS has been appointed chief engineer of the *West Virginia Midland Ry.*, office at Grafton, W. Va., succeeding Wm. Harry.

Bridges and Buildings.

EDWARD DRURY has been appointed general foreman of bridges and buildings of the *Atchison, Topeka & Santa Fe Ry.*, at Newton, Kan., succeeding C. E. Elmore.

G. THOMAS has been appointed master carpenter of the *Cincinnati, Hamilton & Dayton Ry.*, at Dayton, O., succeeding H. Miller.

J. D. MOEN, formerly foreman of bridges and buildings of the C. & N. W. Ry., at Boone, Ia., has been appointed superintendent of bridges and buildings of the *Chicago, St. Paul, Minneapolis & Omaha Ry.*, office at St. Paul, Minn.

J. H. DE BORD has been appointed general foreman of bridges and buildings of the *El Paso & South Western System*, at Douglas, Ariz., succeeding P. F. GENTINE.

T. B. BOLIN has been appointed supervisor of bridges, buildings and track of the *Lancaster & Chester Ry.*, office at Lancaster, S. C., succeeding P. W. HARDIN.

J. E. RAWLINSON has been appointed supervisor of bridges and buildings of the *Louisville & Nashville R. R.*, at Lebanon Jct., Ky., succeeding JAS. INGRAM.

E. GUILD has been appointed supervisor of bridges and buildings of the *Pere Marquette R. R.*, at Grand Ledge, Mich.

United States Valuation.

C. B. SPENCER, formerly office engineer, St. Louis & San Francisco R. R., has been appointed senior civil engineer in charge of the road and track department of the western district of valuation, Interstate Commerce Commission. F. B. SCHEETZ, from 1910 to 1914 employed with the Kansas City Bridge Co., has been appointed engineer in charge of the structural department. WM. K. WALKER, formerly with the Missouri Pacific Railway, has been appointed engineer in charge of a field party at work on the Texas Midland Railway. LOUIS HOOD has been appointed engineer in charge of the field party at work on the Kansas City Southern Railway. The headquarters of the above appointees is at Kansas City, Mo.

GEORGE H. BRENMER, formerly district engineer of the Chicago, Burlington & Quincy R. R., has been appointed engineer of the central district, office at Karpen building, Chicago. J. BEAUMONT, formerly signal engineer of the Chicago Great Western R. R., has been appointed signal engineer of the central district, office at Karpen building, Chicago.

CHARLES E. LEE.

In connection with the reported retirement of Morris McDonald from the presidency of the Boston & Maine R. R., many names have been mentioned as a possible successor. Among the men who are eligible and capable, the name of Charles E. Lee has been prominently mentioned. Mr. Lee was connected with the B. & M. R. R. for 21 years, and as general superintendent had the good will of the employes, while his intimate knowledge of the physical property places him in a strong position as a possible head of the system.

CONCRETE DEPARTMENT

Puddling or Ramming Concrete After Placing.

When concrete first came into use dry mixtures were used almost exclusively and in order to obtain compact and dense concrete considerable tamping was necessary. Times have changed, however, and nowadays nearly all concrete, except that placed under the direction of students of the "old school," is mixed wet, and ramming or tamping dispensed with entirely, the mixture being churned or puddled just enough to remove the entrained air.

Still, we occasionally hear of some superintendent, inspector or engineer in charge of construction work, demanding that concrete, even if it is wet, be placed in six-inch layers and thoroughly tamped. With such concrete, tamping defeats its very purpose, for the top will be flooded with water mixed with pure cement, thus robbing the concrete of cement and reducing its strength and making the concrete of a non-uniform mixture by forcing the large aggregate to the bottom. A wet mixture of concrete such as can be spouted by gravity *should never be tamped or rammed* with heavy tools; stirring, spading or puddling with forks, spades or rods is all that is required to allow the entrained air to escape and the voids to be filled. When wet concrete is used it is also very important to see that the concrete be placed or poured in such a way as to prevent the formation of air pockets, thus reducing the puddling or spading necessary.

Even with dry concrete there are dangers to be incurred by "too much tamping"; that is by forcing the stone to the bottom and weakening the concrete by disturbing it after setting has begun. As in most work there is a happy medium which must be struck in order to obtain the best results in ramming or puddling concrete.

When wet concrete is used the rate of progress of the work is much more rapid than where dry concrete is used since it can be placed in thicker layers and requires less attention in the matter of puddling if carefully placed. Wet concrete, then it can be said, is the result of the general tendency toward the use of more economical methods in concrete construction work.

THE ECONOMY OF USING BULK CEMENT.

Mr. H. A. Strauss, president of the H. A. Strauss Co., contractors, Chicago, now building the Baldwin Locomotive Co. plant at East Chicago, sums up the advantages of bulk cement in a most convincing manner, in a letter to the Universal Portland Cement Co. The advantages cited are:

(a) Elimination of relatively large cost of individual handling of cement in sacks, viz: 1. Handling from car to storage shed. 2. Handling from storage shed to mixer. 3. Handling at mixer when charging. 4. Handling of empty sacks for return. 5. Shipping empty sacks to mill.

(b) Elimination of the deposit account of 40c per barrel of cement, which stands against the purchaser's account until the empty sacks are returned in good order.

(c) Elimination of the charge against the contractor for loss of mutilated sacks, which in practice works out as an increase in cost of cement, ranging from 5% to 10%.

(d) Elimination of the cost of a cement storage shed distinct from the charging bin.

(e) Reduces cost of dry mixing. In our case two men at the three spouts handle all gravel, sand and cement, simply by operating the discharge valves.

In addition to these are the advantages due to concentration of the plant, and therefore, simplicity of operation and rapidity of supplying raw material to the mixer.

Mr. Strauss says: "We are quite enthusiastic about this bulk cement proposition and we recommend it to the careful study of every concrete contractor."

The plant was designed especially for the use of bulk cement, consisting of three bins, a clam shell bucket, a hoisting engine, a special bulk cement hoist and a concrete mixer. The cement is stored in a central bin above the side bins containing sand and gravel and is provided with a watertight roof and with a capacity of a small carload of bulk cement. The sand and gravel bins are of such capacity as to provide the requisite amount of sand and gravel for use with this amount of cement in a 1:3:5 mixture. The mixer is located at ground level, directly under the cement bin. The cement is chuted into a measuring box with a dumping bottom, while the sand and gravel are chuted directly into the divided hopper. Two men control the chutes, water supply and gate to mixer.

The plant has been used successfully for several months with a decided saving over the old methods and without any trouble whatever from moisture.

The use of bulk cement is at the present time not very extensive, but it is safe to say that before long, sack cement will be used only on small work and in those localities where conditions of transportation make the use of bag cement more economical and satisfactory.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—Prices given are f. o. b. cars at points named, including cloth sacks, for which, in general 40 cents per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, $1.72; New York, $1.58; Chicago, $1.45 to $1.52; Pittsburgh, $1.50; New Orleans, $1.78 on dock; Memphis, $1.82; Cleveland, $1.65; Detroit, $1.59; Indianapolis, $1.53; Peoria, $1.68; St. Louis, $1.55; Chicago, $1.45; Milwaukee, $1.50; Minneapolis & St. Paul, $1.60 to $1.65; Montreal, $1.75 to $1.80; Toronto, $1.90; Winnipeg, $2.40 to $2.50; Kansas City, $1.59; Omaha, $1.73; Portland, Ore., $2.20; Spokane, $2.30; Seattle, $2.10; Tacoma, $2.10.

Crushed Stone—1½ in. stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 85c to 95c, in full cargo lots at the docks; Chicago, $1.15; Toronto, 75c per ton at quarries; Spokane, $1.25; Seattle, $1.25; Portland, Ore., $1.00.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 85c to 95c, in full cargo lots at docks; Chicago, $1.15; Portland, Ore., $1.00; Spokane, $1.25; Seattle, 85c; Winnipeg, $1.85; Tacoma, 65c.

Sand—Prices are per cubic yard, f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, $1.15; Toronto, $1.15; Portland, Ore., $1.00; Spokane, $1.00; Seattle, 95c; Winnipeg, $1.75; Tacoma, 65c.

Reinforcing Bars—The demand is light and prices in general have dropped about 5c per hundred lbs. below those given last month. Pittsburgh base quotations on mill shipments f. o. b. cars, are from $1.20 to $1.25 per cwt., with the prevailing extras on bars under ¾ inch or base. The following are quotations on base bars per 100 lbs., for mill shipments from other points,

f. o. b. cars: Chicago, $1.38 to $1.43; Portland, Ore., $2.05; Spokane, $2.70; Seattle, $2.05; Tacoma, $1.90.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, $1.75; New York, $2.15; Cleveland, $1.75; Cincinnati, $1.75; Chicago, $1.85; Montreal, $2.15; Toronto, $2.25; Winnipeg, $2.50; Portland, Ore., $2.40; Spokane, ——; Tacoma, $2.25; Seattle, $2.25.

Metal Clips for Supporting Bars—$7.25 to $8.00 per 1,000 depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Concrete Steel Co., American Sand & Gravel Co., Chicago, and F. T. Crowe & Co., of Seattle, Portland, Spokane and Tacoma.

Reinforcing bars for mill shipment are in general sold on a Pittsburgh basis; that is, at the Pittsburgh quotation plus the freight to the point in question, and with the following list of freight rates on finished material and the Pittsburgh quotation given, the price of bars at any of the points listed can be readily computed.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Columbus	12 cents
New York	16 cents	Cincinnati	15 cents
Philadelphia	15 cents	Louisville	18 cents
Baltimore	14½ cents	Chicago	18 cents
Boston	18 cents	Richmond	20 cents
Buffalo	11 cents	Denver	84½ cents
Norfolk	20 cents	St. Louis	22½ cents
Cleveland	10 cents	New Orleans	30 cents
Birmingham	45 cents		

Concrete Practice No. 10, P. & R. Ry.*

By A. M. Wolf, C. E.

The Philadelphia and Reading Ry. uses concrete in the construction of a number of types of structures such as arch bridges, culverts, piers, abutments, slab bridges and floors for steel bridges. A number of the standard designs are shown in detail and described herein.

Plain Concrete Piers and Abutments.

Piers and abutments are designed for truss reactions, due Cooper's E-55 live load with impact and dead load of structure. The bearing on bridge seats is assumed as 400 lbs. per sq. in. All parts except the bridge seats, back walls and copings are of 1:3:6 concrete, while the latter are of 1:2:4 concrete. All edges except lower edges of copings are slightly rounded by placing fillets in the forms.

The standard pier has a top width of 5 ft. 6 in. over the coping 2 ft. thick, which projects 4 inches beyond the neatwork. The height above the footing is about 15 ft. and the width at the footing 6 ft. 8 in., making the latter about ¾ in. per foot. The footing course projects 6 in. beyond the neatwork of the pier and is carried down to a suitable foundation. The upstream end has a 45 degree cutwater the entire height of pier, while the downstream end is square. The length of piers varies in accordance with the width of bridge and the degree of skew or curve, if such a condition exists. The pier shown is placed on about a 40 degree skew and is 45 ft. long under coping, being designed for a double track bridge.

The plain concrete abutment shown is of the combination straight and splayed wing type. The main portion is 16 ft. 1½ in. high from footing to bridge seat to top of footing course, which projects 6 in. beyond the neatwork at the face. A batter of ½ in. per foot is maintained on face and the back is stepped off in 4 ft. steps, as shown, in order to obtain the desired base width, which is usually equal to about 0.4 the height.

The bridge seat is made 3 ft. 7 in. wide, with a coping 2 ft. deep projecting 4 in. beyond the neatwork. The back wall of plain concrete, has a vertical face and a top width of 2 ft.

The wings have 12-inch copings 2 ft. 6 in. wide projecting 4 in. beyond the face, and the tops are sloped off on a line following closely the slope of fill. The faces are given a ½ in. to the foot batter, while the backs are stepped off in the same manner as the main portion of the abutment.

Reinforced Concrete Culvert.

The box culvert, details of which are given, is of a somewhat unusual design insofar as layout is concerned. The inner dimensions are 15 ft. by 8 ft. high at the sides with the bottom concave so as to give a height of 9 ft. along center line. The cover slab is of reinforced concrete, while the remainder is of plain concrete of a 1:3:6 mixture; 1:2:4 concrete being used in the cover slab.

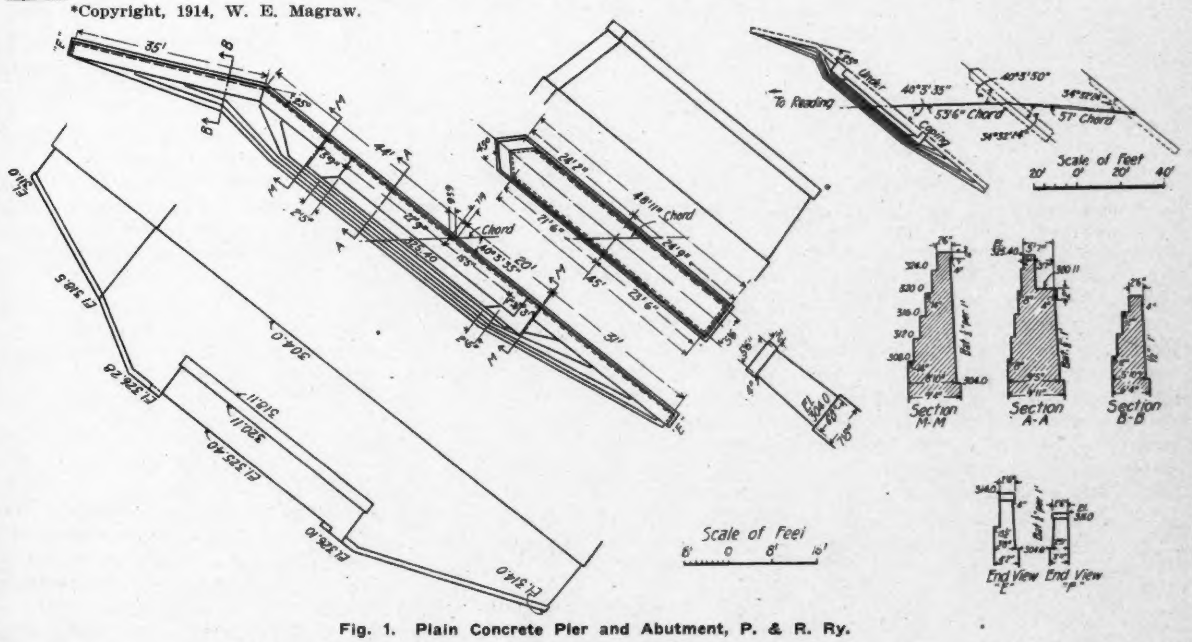


Fig. 1. Plain Concrete Pier and Abutment, P. & R. Ry.

The live load used in design was the equivalent of Cooper's E-55. The allowable compression unit stress in concrete used was from 600 to 700 lbs. per sq. in., and the tension in steel reinforcement 15,000 lbs. per sq. in.

In order to avoid a skew crossing, which would have made the construction without the removal of the old pile trestle very difficult, the layout shown was used. This consists of a straight portion 18 ft. 6 in. long, each side of the center line of track perpendicular thereto, joining a curved portion at either side, an eighth of a circle, with a radius of 45 ft. 6 in. while the end portion continues at 45 degrees to the center line of the portion under the track, the two ends extending in directly opposite directions.

The sidewalls of plain concrete, 3 ft. thick, rest on a footing slab 2 ft. thick at the edge and 22 ft. wide, projecting 6 inches beyond sidewalls. At the center the thickness of bottom slab is 1 ft. 6 in., thickening to 2 ft. 6 in. at the junction with sidewalls.

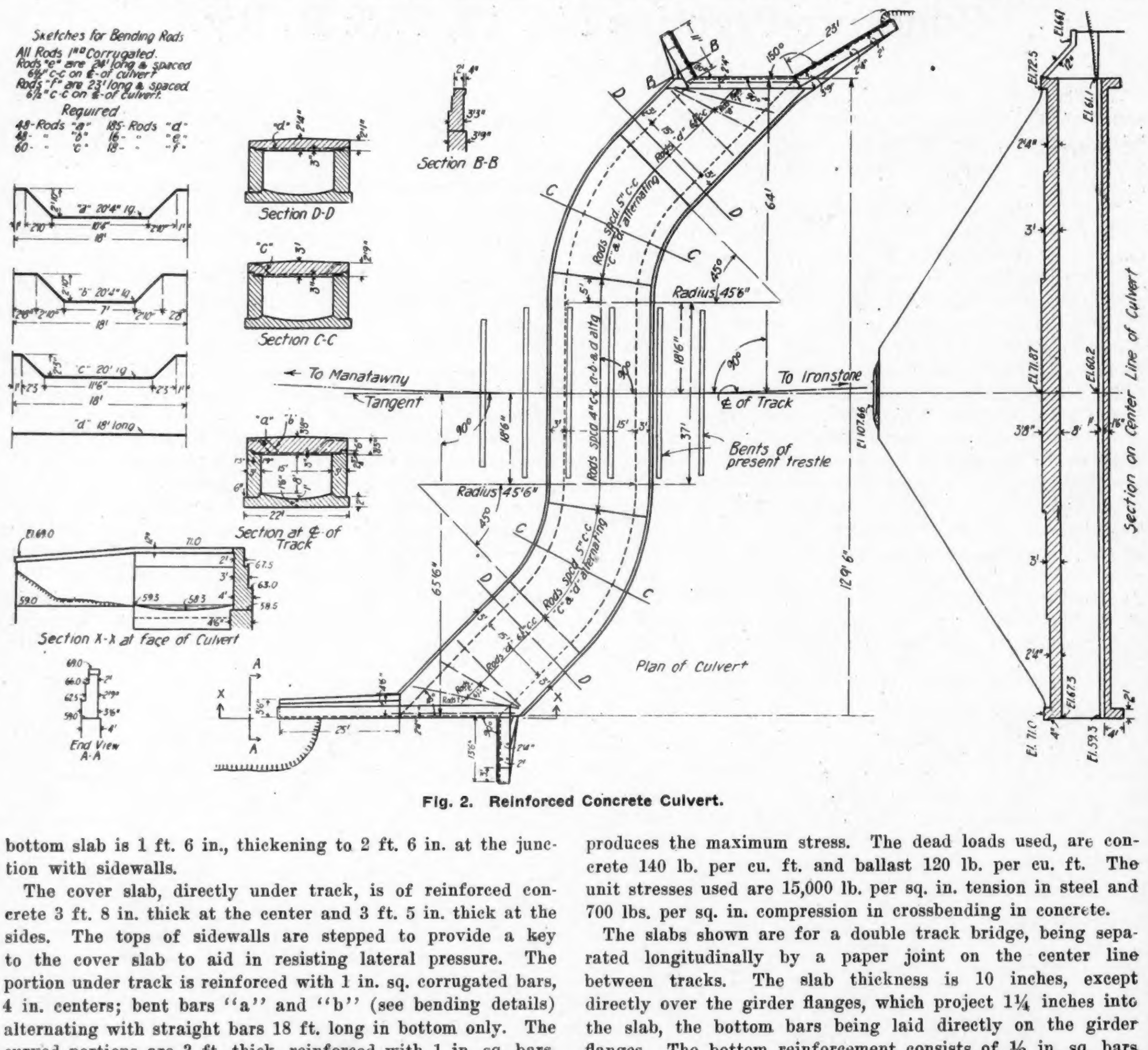


Fig. 2. Reinforced Concrete Culvert.

The cover slab, directly under track, is of reinforced concrete 3 ft. 8 in. thick at the center and 3 ft. 5 in. thick at the sides. The tops of sidewalls are stepped to provide a key to the cover slab to aid in resisting lateral pressure. The portion under track is reinforced with 1 in. sq. corrugated bars, 4 in. centers; bent bars "a" and "b" (see bending details) alternating with straight bars 18 ft. long in bottom only. The curved portions are 3 ft. thick, reinforced with 1 in. sq. bars, 5 in. centers, alternating, one bent and one straight bar. The remainder at each end is 2 ft. 4 in. thick and reinforced with 1 in. straight bars in bottom on 6½ in. centers. At the ends a parapet with a projecting coping 12 in. deep retains the fill.

Plain concrete wings protect the embankment from wash at the ends of culvert. To prevent scour the footing slab terminates in a baffle wall 2 ft. thick and 4 ft. deep at each end of the culvert. The culvert has a slope of about 2 ft. from one end to the other.

The showing faces of concrete are second and have a granolithic finish produced by depositing with the concrete a facing of at least one inch, composed of one part cement, two parts sand and two parts granite or trap rock grit. The face forms were removed as soon as the concrete had set sufficiently and the faces washed until the grit was exposed, making a uniform surface.

Reinforced Concrete Floor for Deck Girder Spans.

The type of floor illustrated is for ballast floor deck girder spans only. The concrete used is of a 1:2:4 mixture. The slabs are designed for Cooper's E-55 live loading with impact allowance in accordance with the formula $I = S\frac{300}{L+300}$, where I = amount to be added to live load stress; S = the calculated live load stress; L = length in feet of loading, which produces the maximum stress. The dead loads used, are concrete 140 lb. per cu. ft. and ballast 120 lb. per cu. ft. The unit stresses used are 15,000 lb. per sq. in. tension in steel and 700 lbs. per sq. in. compression in crossbending in concrete.

The slabs shown are for a double track bridge, being separated longitudinally by a paper joint on the center line between tracks. The slab thickness is 10 inches, except directly over the girder flanges, which project 1¼ inches into the slab, the bottom bars being laid directly on the girder flanges. The bottom reinforcement consists of ½ in. sq. bars 9 ft. 6 in. long, spaced 4 in. centers, while the top reinforcement from edges of slab to points near middle consists of two sets of ½ in. sq. bars, 5 ft. 6 in. long, spaced 6 in. centers. No longitudinal reinforcement is used. At the outside edges of slabs concrete parapets about 16 in. high are formed to retain the ballast. These curbs are tied to the slabs by ½ in. sq. bars, 2 ft. long, placed on the diagonal at 6 in. spacing. A low curb is formed at the point between slabs to prevent seepage through the joint.

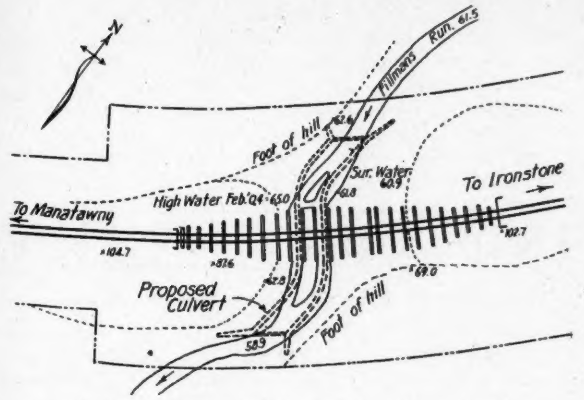


Fig. 3. Location Plan, Reinforced Concrete Culvert.

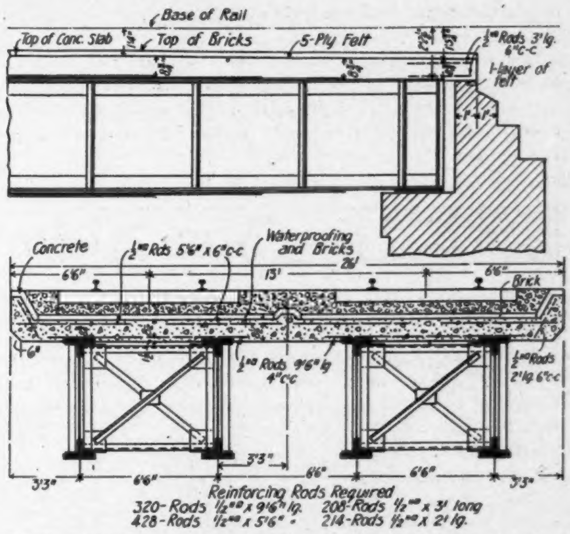


Fig. 4. Reinforced Concrete Floor Slab—Deck Girder Spans.

The slabs are waterproofed and then covered with a layer of brick upon which the track ballast is placed. At the ends of bridges where the slabs rest on the backwall of abutment, they are reinforced longitudinally with ½ in. sq. bars, 3 ft. long, placed in two rows, one near top and one near bottom of slab at 6 in. centers. A layer of felt is placed on the back wall so that the concrete surfaces will not adhere to each other.

I-Beams Encased in Concrete Slab.

For low crossings where the river prism is limited and a shallow floor is necessary the type of structure shown, viz., I-beams encased in concrete slabs carried on plain concrete piers and abutments, is quite frequently used.

The plans shown are for one-half of a future double track skew structure, the remaining half to be built later. The slab is 17 ft. 3 in. wide over-all with a thickness of 2 ft. 1 in.

The main I-beams, eleven in number, are 20 in. 65 lb. sections, spaced 1 ft. 1½ in. centers with 2 in. of concrete protection on the bottom and 3 in. on top. For the 20 ft. spans. The outer portion of the slab under the parapet is carried by two, 15 in., 42 lb. I-beams, 1 ft. 5¼ in. apart, the outer one 9 inches from face. These beams are tied together and to the outer main beam at the ends by ½ in. sq. hook bars.

The outer parapet is 2 ft. 4 in. wide, with a projection of 4 in. beyond the face of slab, forming a coping 1 ft. thick. The total depth at the parapet is 3 ft. 4 in. At the inside, that is, along the side designed for future extension, a curb 2 ft. wide and 6 in. high is formed; this portion is carried by a 20 in. 65 lb. I-beam.

The slabs are waterproofed and sloped so as to drain through 3 in. drains at abutment and every second pier. Ballast is placed on the slabs to a depth of 15 inches. The slabs and copings are of 1:2:4 concrete, while the piers and abutments are of 1:3:6 concrete.

The showing faces of concrete are scored and have a granolithic finish, produced by depositing with the concrete a facing at least 1 in. thick, composed of one part cement, two parts sand and two parts granite or trap rock grit. The face forms were removed as soon as the concrete was sufficiently set and

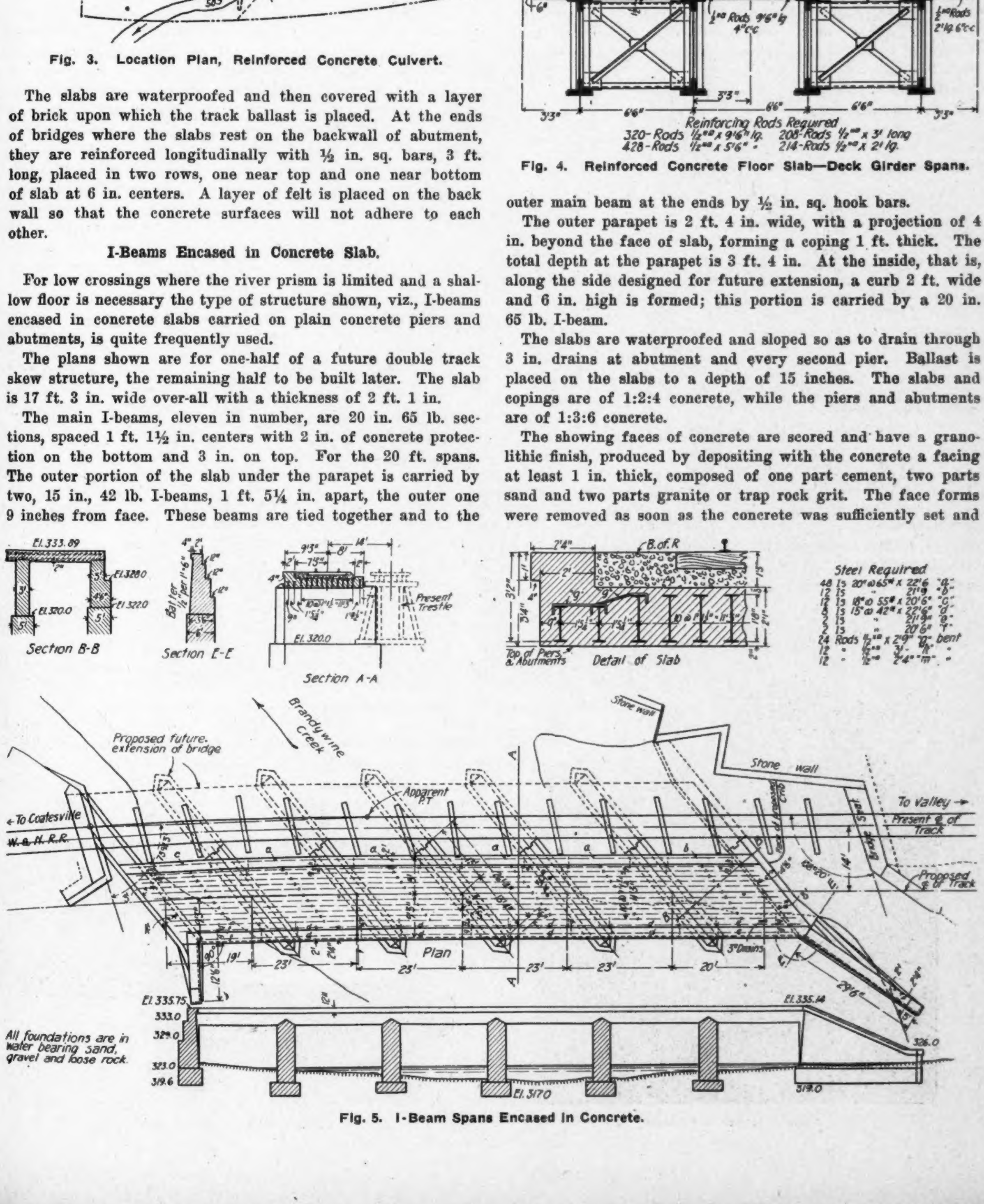


Fig. 5. I-Beam Spans Encased in Concrete.

the faces washed until the grit was exposed, making a uniform surface.

I-beam bridges are designed for the same live and dead loads as are used in the design of reinforced concrete floors for deck bridges. The I-beams are designed to carry the entire load, the concrete being considered merely as protection.

Comment.

The design of the structures described indicates that reinforced concrete is not used as extensively by this road as by some others whose designs have previously been described, but considerable plain concrete seems to be used. We are indebted to Mr. William Hunter, chief engineer, Philadelphia & Reading Ry., for plans and data used in making up this article.

The Signal Department

A COMPARISON OF THE PANAMA CANAL LOCKS WITH A RAILWAY INTERLOCKING PLANT.

The Panama Canal, which will soon be open to the world as a waterway, stands as a monument to the engineering genius of this generation. The universal interest results mainly from the immensity of the canal project itself, while the engineering developments offer to the engineering mind a lively interest and an opportunity for much valuable instruction.

The complete operation of the canal locks, terminals and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama Railroad.

The specifications for the entire generating, lock controlling and distribution system for operating the Panama Canal were prepared under the supervision of Mr. Edmard Schildhauer, electrical and mechanical engineer, Isthmian Canal Commission, assisted by a staff of able electrical engineers, including Mr. C. B. Larzelere, who was closely identified with the lock control problems, and Mr. W. R. McCann, identified with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

The engineers of the Isthmian Canal Commission had the same object in view, when they installed the centralized control system for the operation and protection of the canal locks as the railway officials have when they install an interlocking plant at a busy point, junction or crossing. The reasons for adopting a power transmission of control rather than a mechanical transmission of control, in the case of the operation of the canal locks, are no different than the reasons for installing a power interlocking rather than a mechanical interlocking on a railway.

Reasons for Using the Control System Adopted.

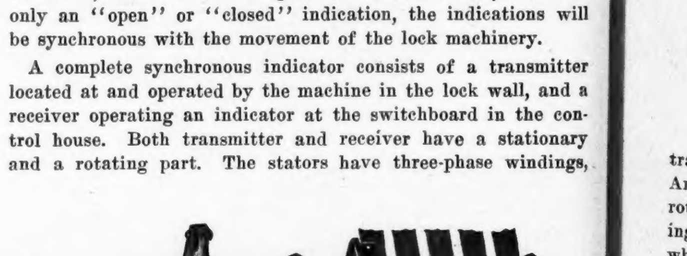
As the flight of locks at Gatun, for instance, extends over approximately 6,200 feet, and the principal operating machines are distributed over a distance of about 4,000 feet, it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invariably been the practice heretofore. Such a force would be difficult to co-ordinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number of operators, operating expense and liability to accident. To accomplish this system of control, a control board for each lock was constructed, which permitted having all control switches located thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.

Centralized Control and Indicating System.

In comparison with a railway power interlocking plant, the centralized control system for the canal locks are in many ways identical. In both cases it is necessary to employ some method of indication so that the operator will know the position of the functions under his control. The control boards are installed in control houses located on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water levels in the various lock chambers; and with the exception of such machinery as needs only an "open" or "closed" indication, the indications will be synchronous with the movement of the lock machinery.

A complete synchronous indicator consists of a transmitter located at and operated by the machine in the lock wall, and a receiver operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have three-phase windings,

Control House at Gatun.



Control Switch, with Interlock Mechanism.

with leads from three corresponding equidistant points brought out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110-volt 25-cycle single-phase source.

The movement of the lock machinery, and with it the connected transmitter rotor, produces a field in the transmitter stator polarized in the direction of the rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the three-phase connection above mentioned to the receiver stator coils and duplicates in them, but in the reverse direction, the same conditions of polarity and voltage as present in the transmitter. The rotor of the receiver being energized by the external source in the same direction as that of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the position indicator a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows.

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack engages a gear on the rotor shaft, and this turns the rotor as the gates operate. The mitering gate indicator comprises a pair of aluminum leaves, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened, they are covered by shields to give the effect of the gates folding back into recesses in the lock walls.

For the chain fender, the position indicator transmitter is driven by the shaft which operates the limit switch that controls the stroke of the piston. The indication on the board is given by a small aluminum chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board. The ends of the miniature chain are fastened to semaphore arms which are connected to segmental gears meshing with the driving gears on the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

Interlocking System Below Miraflores Board.

As the rising stem valves occur in pairs, their position indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, a car being used to indicate the position of the valve gate. Both front and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½ and ¾ positions. A small aluminum cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is located underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is always illuminated and the portion above is dark.

Water Level Indicators.

The specifications covering the water level indication required an accuracy of one-twentieth of a foot or one-tenth of 1 per cent in actual water level. In the transmitters and receivers

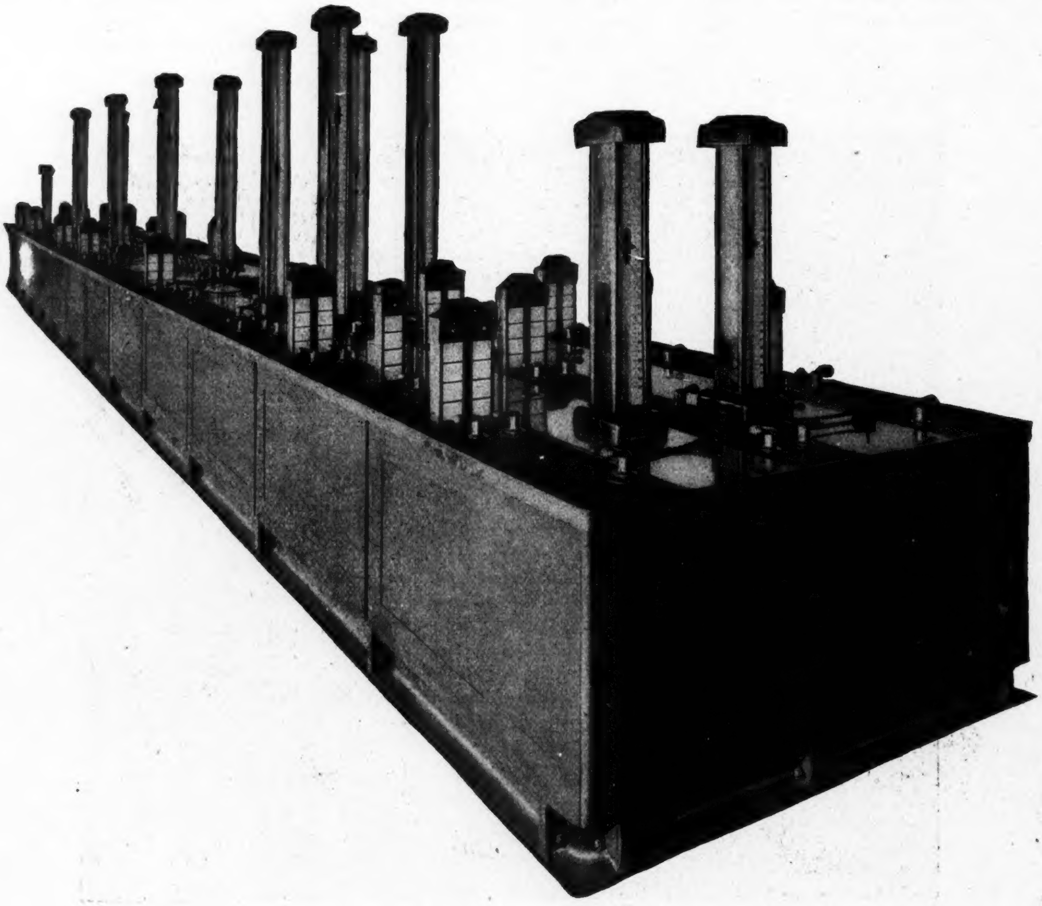
for the machines described previously, the rotors turn less than 180 degrees with an inherent lag of 1½ per cent between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water level indication.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180 degrees, or in twenty different positions for the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned

shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control board representing the machine.

It can be seen from the above that with the canal locks the indication system is much more elaborate than with an interlocking machine at a railway plant. In the one case the indications are continuous, while in the other a normal and reverse indication seems to be all that is necessary.



Centralized Contral Board for Miraflores Lock.

more than one-half revolution with the power off. Therefore, the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions and the other set connected to a coarse index operating less than 180 degrees.

The fine index is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminum ball representing the coarse index, which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct within the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water level indication, wells 36 inches square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges, contain a welded steel box float, 30 inches square by 9 inches deep. A non-slipping phosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave

Control Boards Represent Locks in Miniature.

The control boards are of the flat top benchboard type, 32 inches high by 54 inches wide, built in sections, with total lengths as follows:

Gatun	64 feet
Pedro Miguel	36 feet
Miraflores	52 feet

The side and center walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by a brass trim rail, and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90 degrees. They are provided with name plates for the "open," "closed" and "off" positions. The space immediately below the flat top

of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, and by synchronous receivers and their cable connections. Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, for receivers and for the lamps that illuminate the scales of indicators. The receivers, transmitters and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25-cycle alternating current.

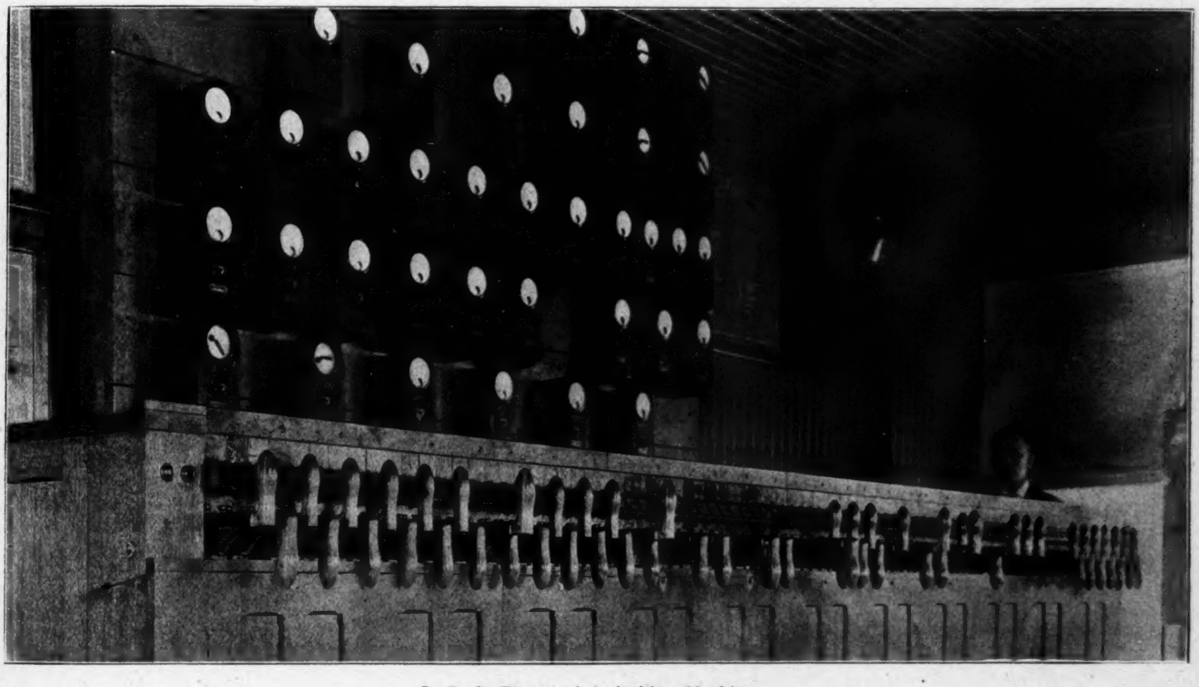
The comparison between the control boards used to operate the canal locks, and an interlocking machine used to control switches, signals, etc., shows up very nicely in the illustrations herewith. In both cases the operation of the levers depends upon the position of the mechanical locking, which forms a part of the controlling machines. The mechanical locking is so designed that it is impossible to move the levers or switches, except in a certain predetermined manner.

Mechanical Interlocking System.

In order to make it necessary for the operator to manipulate the control switch handles always in a certain order, corresponding to a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with interlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switchboard operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below.

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks. The interlock system is essentially a bell crank mechanism, connecting the shaft of the control switch through a movable horizontal bar to a vertical operating shaft which can or can not move, according to the relative positions of the interlocking bars and dogs. The interlocking rack is a steel frame carrying five horizontal members. Upon these and tying them together are vertical steel straps, which carry brass runway posts for the vertical and horizontal interlock bars. These posts are riveted to the vertical steel straps, a thin brass plate between posts and straps making the runways non-corrosive. The vertical operating shafts are of square steel turned on the ends, and work in brass bearings near top and bottom of the interlocking rack. Forked cranks mounted on the vertical operating shafts move the horizontal interlock bars by means of pivot blocks set over pin blocks riveted to the horizontal bar. The interlock bars and dogs are of special shape, hard extruded brass, which section keeps the dogs in line with the axis of the bars when under pressure by being engaged with another dog on a vertical bar. Every control switch uses a horizontal bar of from 3 to 50 feet long.

The interlock system depends mainly on the action of engaging bevel dogs located on horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar can not be moved without raising a vertical bar. Thus if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages with the vertical bar can take place, and the control handle connected to that particular horizontal bar is locked.



G. R. S. Electric Interlocking Machine.

Interlocks prevent the chain fender from being lowered until adjacent mitering gates have been opened, and also prevent the gates being opened until the chain is in the raised position. In this way it is assured that the chain fender will always be in the up position to protect the gate when the gate is closed. To avoid unnecessary complication, each end of the chain is interlocked with the leaf on its side of the lock only, because as a rule both leaves of a gate, as well as both ends of a fender chain, will be opened simultaneously, and further interlocking is unnecessary. After the mitering gates are closed, a miter forcing machine is operated by a control handle and locks the ends of the gates closed. This machine cannot be operated until the gates are closed.

Also the rising stem valves of the side wall, next above or below a miter gate, must be closed while the miter forcing machine is open. As the miter forcing machine cannot be closed until the gates are closed; this means that the valves

either above or below the gate must remain closed until the gate itself is closed, thus preventing the operator from creating a current of water around the gates while they are open or being moved in opening or closing. This interlock is not included on the middle wall valves for the reason that they will be used with the locks on either side and must be free for that purpose.

Either pair of rising stem valves may be opened first, at the choice of the operator, an interlock becoming effective when the first valve of the second pair of duplicates is opened. This is done by a novel arrangement of equalizing levers acting against the ends of the interlock bars, with certain definite amount of lost motion which is taken up on opening the first pair of valves, thus putting the interlocks in operation on the next pair. To illustrate this operation, consider, for example, a side wall culvert at Gatun with its principal rising stem valves at each change of level from one lock to the next. The control of these valves is interlocked so that if the valves are opened at one particular point, the valves a lock length upstream or downstream cannot be opened. Thus the operator is limited to equalizing the water between locks and cannot allow water to flow from the upper lock past the middle lock into the lower lock, which operation, if permitted, might flood the lower lock walls and the machinery chambers in them. The cylindrical valves are interlocked so that if those on one side are opened the ones on the other side are locked closed and the opening of one switch on a side will lock the opposite ten. This prevents careless cross filling between locks, which operation might be combined with the regular method and produce flooding. However, there may be times when it is desirable to employ cross filling to economize in the use of water from Lake Gatun in the dry season. For this reason this interlock is made removable by the use of a Yale lock and key. The key will be placed in the hands of the chief operator.

In the use of the middle wall culvert, the cylindrical valves on one side or the other must be opened before the rising stem valves can be opened, and the rising stem valves must be closed first. This interlock is applied in order to require the operator to control the flow of water by means of the rising stem valves rather than by the cylindrical valves.

In most cases the locks are divided into two unequal parts by the intermediate mitering gates. This arrangement makes it necessary to divide the ten cylindrical valves into two groups of seven and three, respectively, for the long and short lengths. A selecting lever is provided for these interlocks and may be set as indicated by a name plate on the lever to "three," "seven" or "ten," respectively; whereupon the corresponding valves are subject to that interlock, and the others of the group of ten are locked closed if three or seven only are to be used. The failure of the operator to make his selection properly in advance will simply cause him the trouble of going back and doing so, as the remaining valves are locked closed. This arrangement permits handling small vessels without causing waste of water due to operating such vessels in the large chambers. If a short vessel were being passed downstream, it would first pass into the chamber having three cylindrical valves. The group selective lever would then be placed on the "three" position, which would permit the opening of three valves above the intermediate gate, but would lock closed the other seven valves above it. After the vessel had been passed below the gate the handle may be reversed, releasing the lever and locking three switches.

There are intermediate rising stem valves in the side walls at each intermediate gate, but no interlocks are applied to these, for the reason that they will be used in a more or less irregular manner, and no fixed laws for their operation can be made in advance. Moreover, they control the water only between different sections of the same lock, and there is not the danger from mistakes in operation which exists in the case of the other valves which control water between lock levels. The same is true of the small auxiliary culvert valves, by means of which the space between the upper guard gate and upper main gate is filled and emptied.

In case a large vessel is to be locked through, the interlocks on the intermediate gates can be made ineffective by the operation of a Yale lock, which uncouples a clutch and disconnects the central switch from the operating mechanism. Turning the key removes the interlock and permits the intermediate gates to be thrown open to obtain a 1,000-foot level and the valves operated independently of these gates.

To obviate the possibility of flooding the locks when valves are in a certain position, diagonal interlocking is introduced between the rising stem valves of the side wall and those of the middle wall a lock length away. This interlocking between valves diagonally across a lock when the cylindrical valves are open is needed to prevent the flow of water from, say, the upper lock by way of a side wall culvert to the middle lock, thence by way of the middle wall culvert to the lower lock, thus allowing an operator, through carelessness, to flood the lower lock walls. If the cylindrical valves of a certain lock are closed, the interlock is not needed on the rising stem valves of that lock; and since such interlock would interfere with the proper use of the valves of its twin lock on the other side of the middle wall, this interlock is automatically removed when all ten cylindrical valves are closed on the particular lock in question, and is automatically applied again if one or more of the ten cylindrical valves are opened. Furthermore, the valves of the side wall immediately at the gate which is being moved will be open to equalize water level, and diagonal interlocking will prevent the opening of the middle wall valves a lock length above or below the gate being moved. Each of the four valves of such a group has independent control, their control switches being so interlocked that either pair may be opened and left open as guard valves, the interlocks becoming effective when the operator tries to open the first valve of the second pair. In addition to these pairs of valves in parallel, each pair is duplicated at each change of level from one lock to the next.

Comparing outside apparatus at the canal locks with outside apparatus at an interlocking plant, the mitering gates compare very well with interlocked signals and the chain fenders with the interlocked derails.

The Mitering Gates.

The mitering gates consist of two massive leaves, pivoted on the lock walls, which operate independently of each other. A pair of gates is located where each change of level occurs and divides the locks into 1,000-foot chambers. In addition to these gates, at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1,000-foot locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed they are what might be termed clamped in this position by a device called a miter forcing machine. Vessels cannot pass unless the gates are open.

The Chain Fenders.

The chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed is accomplished by two motors, one driving the main pump supplying water under pressure, and the other operating a valve which

controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

The General Electric Company manufactured the locking machinery and other electrical apparatus for the canal locks, and we are indebted to them for the information and photographs describing and illustrating them.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

J. Beaumont, signal engineer of the Chicago Great Western R. R., has resigned to become senior signal engineer of the U. S. Valuation Board, third district, office at Chicago, and F. G. White, formerly signal inspector of the Northern Pacific Ry., has been appointed signal engineer of the *Chicago Great Western R. R.*, office at Chicago.

J. Sheehan has been appointed signal inspector of the *Chicago, Milwaukee & St. Paul Ry.*, at Milbank, S. D.

C. F. Burgess, signal supervisor of the *Missouri Pacific Ry.*, has been transferred from Falls City, Neb., to Kansas City, Mo. John Sicht, signal supervisor, has been transferred from Nevada, Mo., to Falls City, Neb. M. L. Goehringer has been appointed signal supervisor at Nevada, Mo.

As previously announced in RAILWAY ENGINEERING, Mr. W. H. Fenley was appointed superintendent of telegraph and signals for the *Panama R. R.*, on September 15, 1913. There was a consolidation of the telephone-telegraph and signal departments and the combined department now has jurisdiction over construction, maintenance and operation of telegraph, telephone, singals, electric lights, power and other special electrical features. Mr. Fenley was born at Greenwood, Ind., May 7, 1876, and was educated in the common and grammer schools at Indianapolis, Ind. His railroad experience began in 1894 as a station agent's helper, during vacation. In September, 1895, he was employed as brakeman on the C. C. C. & St. L. Ry., was afterwards yard clerk and then appointed night yardmaster at Greenburg, Ind., March 1, 1896. He began signal work on April 10, 1898, with the National Switch & Signal Co., spent seven months in their employ and then returned to the C. C. C. & St. L. Ry. as leverman and signal maintainer. June 2, 1900, he was employed by the Chicago Great Western Ry., and occupied successively the positions of fitter, foreman, maintainer, electrician, office engineer, inspector and supervisor. He was appointed signal engineer for the Chicago Great Western Ry., in February, 1908, and held that position until he resigned on October 10, 1910, to become sales engineer for the Union Switch & Signal Co., out of their Chicago office. On August 26, 1911, he was appointed signal engineer for the Panama R. R., and sailed at once for the isthmus. Mr. Fenley has been assigned to many special duties on the Isthmus. He was a member of joint committees that made recommendations on the high tension tranmission line, the proposed electrification of the Panama R. R., the locations of sub-stations, power distribution and duct lines in the permanent town sites. He was also chairman of the committee that examined and instructed 600 I. C. C. & P. R. R. trainmen and revised the book of rules.

FORMER RAILWAY MAN APPOINTED CITY MANAGER, TOLEDO, O.

The Commissioners of Dayton, O., the first large city to adopt the plan of appointing a City Manager to head the municipal government, have appointed Henry M. Waite as City Manager. At the time of his appointment, he was city engineer of Cincinnati, O., where in the short period of one year he carried out comprehensive investigations and surveys for a sewerage system and a rapid transit system. He also supervised the design of a number of railway viaducts over streets, in which were attained some strikingly pleasing and artistic effects.

After graduating from Massachusetts Institute of Technology in 1890, he was appointed transitman on the Cleveland, Cincinnati, Chicago & St. Louis Ry., and promoted to assistant engineer in 1891, and to engineer maintenance of way in 1892. In 1893 he was appointed division engineer of the Cincinnati, New Orleans & Texas Pacific Ry., later being appointed roadmaster of the Louisville Southern Ry., and returning to the Cincinnati, New Orleans & Texas Pacific, where he held, successively, the positions of superintendent of bridges, roadmaster, and superintendent, for 13 years. He was employed as superintendent of the Seaboard Air Line R. R. for two years, and was then, until 1912, chief engineer of the Clinchfield Coal Corporation.

It is remarkable that with such a short period in municipal work, Mr. Waite should have been chosen for the position of City Manager. He made an enviable record in Cincinnati, however, where one of his most important tasks was the entire reorganization of the department, and where he obtained in a very short time, a very able staff of engineering assistants.

WASHINGTON'S SURVEY GETS GOVERNMENT O. K.

Government surveyors, who have just been checking up some of the lines reputed to have been run by George Washington in his days of chain and compass work, have found them good.

About 1751, according to tradition, George Washington, then 19 years old, ran cut for Lord Thomas Fairfax the line between what was then to be Augusta and Frederick counties, Virginia, this being only a part of a great deal of surveying which he is said to have been engaged upon at that time. These two counties were separated from what was then Orange county, and the grant to Lord Fairfax was supposed to extend westward to the Pacific ocean. Subsequently these large tracts were further subdivided, so that the "Fairfax line," as it is generally known, runs now between Rockingham and Shenandoah counties, with the original Augusta and Frederick counties to the south and north, respectively.

In the organic act for the formation of the two counties, or "parishes" as they were then called, it was required that the line should be a straight one from the head spring of Hedgman river, one of the sources of the Rappahannock, to the head spring of the Potomac.

Since it was required that the line should be straight, it was first necessary to get the approximate course by building large bonfires on the intervening high points. Then starting from the top of the Massanutten mountains, the line was run straight away over intervening mountains and rivers toward the northwest.

The reason that this old Washington survey line is being retraced is because the Federal Government is purchasing lands in this neighborhood, in connection with the new Appalachian forests which are being acquired at the headwaters of navigable streams, under the terms of the Weeks law, designed to protect these watersheds from the evils of deforestation. The Government requires a clear title before the land can be paid for. In making sure of the titles it is necessary, in many cases, to go back to original royal grants, or to colonial records, and to have recourse to resurveys before the facts of own--ship can be indisputably established.

The Pennsylvania will complete the block signal system from New York to Pittsburgh this year.

The Philadelphia & Reading has placed an order with the Federal Signal Co. for the installation of a 36-lever mechanical interlocking plant at Hopewell, N. J.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY

The Maintenance of Way Department

Causes and Cures for Soft Roadbed.

Several months ago we made a call for articles on "slides and sink holes," on which we have received and published a number of contributions. One of these contributions received lately has taken up a closely related subject, namely, "mud holes." Another article, published in this issue, deals particularly with the drainage on heavy fills.

The cross-sections of these fills, while undoubtedly badly distorted from the conditions at time of construction, still seem to show that too little attention is paid to the placing of earth in fills. When building an earth dam, very careful specifications must be adhered to if the dam is to be waterproof. The law of preservation requires this in an earth dam, which will soon be destroyed if it leaks.

A portion, at least, of this care should be exercised in placing earth in all high railway embankments, but since the absence of these precautions does not lead to total destruction, they are frequently entirely ignored.

The following conditions were once encountered, which somewhat resemble a "mud hole." Track was located just at the foot of a hill with considerable drainage, the track being on a 4-degree curve. The water flooded the track after every rain, and all the elevation would go out of the curve. Several attempts were made to remedy this condition before a real solution of the problem was made.

The methods for overcoming these or any similar or related conditions will be very interesting and acceptable for publication —i. e., on the subjects of slides, sink holes, soft fills, mud holes, or any conditions of soft bottom. The following questions are repeated and may be used as a basis for articles on the above or allied topics:

Description of conditions (with sketch or photograph, if possible). Were slow orders necessary?

Time of first appearance of trouble—during construction or later.

Cause or causes which first brought on the trouble.

Description of difficulties experienced.

Conditions of materials under roadbed, thickness of strata, etc. Were test holes or test trenches sunk, and if so, what information did they disclose?

Methods used to eliminate trouble.

Method which proved effective.

Reason why the method was effective.

All articles submitted and published on the above or allied subjects, viz., causes and cures for soft roadbed, will be paid for at space rates. Address communication to Editor Railway Engineering, 431 South Dearborn Street, Chicago, Ill.

The general manager of the Pennsylvania Railroad recently sent out the following notice:

"Three track laborers were struck and killed by an extra freight on December 26, on one of our divisions at a crossover, while they were engaged in cleaning snow from switches. All of these men wore caps with mufflers to protect their ears. The wearing of ear mufflers by trackmen renders their hearing less acute while being worn, and, while it is not desirable to prohibit the practice of wearing mufflers, foremen should be warned to pay particular attention to the men who wear them, in regard to warning the men of approaching trains."

DRAINAGE OF FILLS AT ORANGEVILLE AND ELDRIDGE BALTIMORE DIVISION B. & O. R. R.

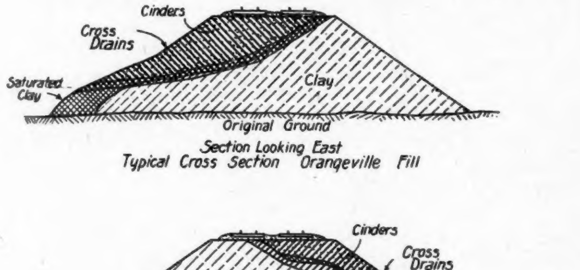
Earl Stimson, Engineer Maintenance of Way.

During the past season, a large amount of drainage work was undertaken on the Baltimore division. Two fills in particular were treated which had given considerable trouble for some time on account of settling, making it necessary to constantly raise and surface the track.

They were the Orangeville fill, which is between Gay Street station and Bay View on the Belt Line, and the first fill east of Eldridge on the Washington branch. The conditions were similar and consequently the same treatment was applied.

Before the work of drainage was commenced, it was thought that the sub-grade had settled under the track, forming water pockets. The fills being of impervious clay, the water could not drain off and gradually softened the material, causing the fill to settle slowly, the material working out at the base.

However, when the drainage work was commenced it was found that this condition did not exist, as will be seen by the



Drainage of High Fills.

cross section which represents typical conditions in both places. The Orangeville fill is 4,400 feet long, but only 200 feet have given any trouble on account of slippage. At this point, the fill is 25 feet high with the slip all on the westbound side. The eastbound track requires no more attention than other points with a fair sub-grade.

The original ground surface is of good supporting material so that the settlement could not be attributed to a poor foundation. The first section cut in the fill was cut down to the original ground to develop any water pockets if they existed. This section was not, however, cut through the entire width of the fill, as the material under the eastbound track was found dry and in good stable condition. From time to time, cinders have been unloaded at this point and used to bring the fill up to normal sub-grade elevation and fill out the shoulder. The first section cut showed the cinder extending to a depth of 12 feet below the top of rail. Underlying the cinder was a layer of slippery saturated clay, about a foot in thickness, upon which the cinder moved toward the toe of the fill. Although it was not marked, there was evidently some movement of this clay which would account for the depth of the cinder under the track.

It is probable that this condition is the result of water pockets. The pumping action of passing trains has worked the shoulder of the fill down also, leaving no defined pocket and forming the section shown. Under the layer of saturated clay, the material rapidly became dryer and assumed normal conditions.

Five cross drains were constructed at points where the settlement was most marked. The first section cut having developed the fact that there was no water pocket in the fill, the subsequent cross drains were cut only to a depth sufficient to reach solid material below the layer of saturated clay. No tile was used, the trenches being back filled with cinder.

The fill east of Eldridge is 1,100 feet long with a maximum height of about 30 feet. In this case the settlement was on the eastbound track and for practically the entire length of the fill. Conditions were found to exist here as at Orangeville, except that there was more water, and as at Orangeville, no water pockets were found. Eighteen cross drains were constructed at intervals of about 50 feet. The excavating was cut through a wet material, and back filled with stone and cinder without tile. The cross sections illustrate the conditions as they existed and the cross drains as constructed.

The cost of the work at Orangeville was:

Labor	$711.55
Material	357.37
Total	$1,068.82

The unit cost of $213.75 per cross drain is high, owing to the amount spent on the first drain, which was in the nature of an exploration.

The cost of the work at Elkridge was:

Labor	$ 486.52
Material	550.00
Total	$1,036.52

The unit cost of $57.38 per train is probably a better average on which to base future estimates for work of this character.

During the progress of the work, the track was supported on twelve by twelve inch timbers, placed under the ties, the excavation being made four feet wide, closely sheeted and cross braced. No piling was used to support the tracks.

When it was found that water pockets did not exist, it was thought that the cross drains would accomplish little, but contrary to expectations, the results obtained have been most satisfactory, the beneficial effects being noticeable almost immediately upon the completion of the work, and the stability of the fills increasing rapidly as they dried out.

Results.

A recent inspection has been made at Orangeville and Eldridge. The embankment for the last track built has slid down the slope of the original embankment so far that not much of the original material is left. The second track is now supported mostly by cinders. In time of dry weather this holds itself in fair equilibrium, but in wet weather the water running down the slope of the old embankment carries the new with it. The embankment seems to have thoroughly dried out at the point where the two ditches were dug to the bottom. After the first deep trenches were dug it was decided to dig only shallow ditches on the top of the embankment, digging them down as far as any moisture was found. These, of course, under the conditions effectually drained the water which was standing upon the top of the old embankment, but did not help the track upon the new embankment.

At the point where the deep excavations were made, the slip seems to have been cured, but where the shallow ones were dug, conditions are practically as bad as before. The ballast at the former point is still in line and the track is standing up dry and solid, but in all other points it has settled badly and destroyed the line of the ballast leaving the one point where the deep excavation was made higher than the adjoining track.

The conditions at these two points would indicate that the proper course to take to fully overcome the difficulties would be to dig deep excavations to the bottom of the fill and at intervals of about 50 feet throughout the entire length of the slip and fill with coarse rock and cinder.

CAUSES OF SLIPS AND SLIDES.

Sorabji D. R., Permanent Way Inspector.

There are no more breakages recently on this railway (India) but earth slips and holes do occur on high banks in monsoon (rainy season).

Causes.

(1) Liquefying of certain kinds of soils or sides of the banks by direct beating of the rain and thus separating the cementing particles.

(2) Passage of rain water through the ballast.

(3) Lack of weep holes in culverts, abutments and wing walls.

(4) Effects of mechanical, chemical and organic agents acting upon different soils.

(5) Subsequent raising of the road with ballast, and earth added on sides of embankments.

(6) Holes made by white ants, wood mice, etc., making their abode on slope of banks.

(7) Where embankments are made on marshy land which is unable to sustain the weight of earth ballast and permanent way during rains. Foundation sinks because the marshy earth on the sides of banks is affected by rains and partially caused to liquefy, while the embankment earth is heavier on account of being wet.

(8) Where embankment is made on marshy land in which several sorts of reptiles make their abode.

(9) Clods deposited by contractors while forming new embankments, and earth deposited in uneven layers while under construction.

(10) Grit, sand, branches of trees, roots of trees or other similar substances deposited in lower layers in embankments while under construction.

(11) Original channel of water blocked by a railway embankment, the bed of which is composed of sand, gravel, etc., which allows the flood water to percolate through, slowly at first, but constantly increasing.

(12) Poor finishing of the embankments.

Causes 1 to 6 relate to old banks. Causes 7 to 12 cover faulty work under construction.

Rectifying the above, in case of emergency, can be accomplished by means of driving rows of piles or wooden ties, fence posts or branches of trees from nearest site, driven close. Whatever material is at hand—leaves, grass, etc.—is thrown over the bank or slope to prevent direct beating of rain, and when the slip is under control we allow the water in the bank to strain through the driven piles so that no earth runs with it. The piles are also driven at the toe of embankment slopes on marshy land.

If there are holes in banks or on track they should be puddled with earth and if earth is not available the ballast would do. But the hole should be enlarged to mix the ballast with earth and brought to a little higher level than before. The new-made puddle should be covered with leaves or grass to prevent direct beating of the rains; after abating of the rains the permanent cure is made by means of special material trains.

EDUCATING TRAIN MEN FOR WORK TRAIN SERVICE.

C. L. Van Auken.

One of the hardest tasks that confronts an assistant engineer or general foreman in railway construction and maintenance is the educating of trainmen and operating men for work train service. Some railways, and among these several of the prominent Western Lines, pursue the policy of maintaining entirely separate departments for construction, maintenance, and operating forces. This serves to make the task of educating trainmen more difficult and often proves a hindrance in cases where train crews are properly "broken in" due to the antagonistic feeling between the separate departments.

In the first place the trainmen who one customarily finds

available for work train service, are usually lacking in information as to the details of track and roadway work and hence they are entirely "at sea" as to the reasons for train movements, the next logical move, etc. They should as quickly as possible acquire a knowledge of materials that go to make up a completed railway and from observation and instruction, learn how these materials are handled and placed in final position in the roadway.

For instance, in yard work, where tracks are being raised, it often happens that an unloading crew will bring in a train of fairly good gravel when the light lifts are being made and then for the final lift where better tamping is required, the train crew arrives with a train of mud, clay or boulders. This fault can be remedied where "green" trainmen are employed, by a little co-operation (often a minus quantity on railway construction) between foreman and work train conductor, and the train crew should learn in a comparatively short time what is required and wanted by the foreman.

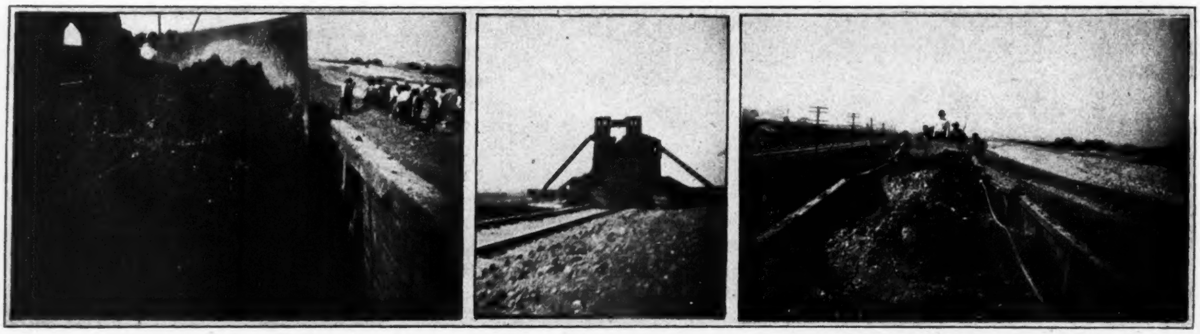
By constantly cautioning new work train crews to keep a record (mental or otherwise) of all switching movements of cars of material pertaining to the job, the general efficiency of work train and material service is increased, for little time is wasted in locating "lost material." A time worn source of trouble, as old as work train service itself, is the sudden announcement of the engineman that it is absolutely necessary to go for water immediately. Too frequently this occurs at a critical point in the day's work where work train service for a few minutes just at that time will help out the day's average considerably. In a great many cases this trouble would have been averted had the train crew taken advantage of idle moments a short time previous.

Here, again, it is up to the foreman or assistant engineer to either personally keep account of the water supply by inquiry, or to educate the train crews to grasp the stragetic points of vantage.

Ordinary "spotting" of cars for unloading materials does not often present many difficulties and yet in a great many cases a little care and forethought by the conductor would facilitate the task of unloading or increase the efficiency of laborers who must later handle the material. In earthwork, however, where machinery is used to a great extent for loading and unloading, it is frequently difficult to get the train crew properly broken in to work with the machinery operators and at the same time obtain the desired efficiency. This is not true to such a great extent in steam shovel loading, as the desired requirements are plainly apparent. It is in unloading with Lidgerwood and plow that we come to grief either by getting the material improperly distributed, by not obtaining speed and efficiency or by burying the rail and causing derailments of cars. We recently saw a conductor, supposed to be experienced in work train service, whose only method of unloading with a Lidgerwood was to "stand and plow," thus burying the rail for an entire train length, causing unnecessary delay and labor to dig out the train, and at the same time distributing the filling exactly the same throughout the train length, regardless of the needs of the adjacent ground. Where varying amounts of filling are required alongside the track, a good plan to follow is to have an earthwork foreman constantly follow the plow in the train and instruct the trainman to "plow heavy" or "light" as the case requires, while the trainman attends only to signaling the Lidgerwood operator to change the speed of the plow, and the engineman to vary the speed of the train.

Spreader work presents similar difficulties in the proper distribution of filing, according to the carrying needs, and in addition somewhat increases the problem of obtaining cooperation between engineman and spreader operator.

The primary object of some spreader operators seems to be to "bowl" over as much dirt as possible without "stalling" the engine, regardless of whether an extra quantity of dirt may be required here and there to fill up a hole and disregarding the fact that hundreds of cubic yards may be pushed out beyond the toe of the slope (as shown by the "slope stakes") where it is useless. The engineman, on the other hand, merely adds steam when he sees he is losing momentum and shuts off steam as he gains momentum, whereas a little foresight as to how the material is unloaded ahead ready for spreading would frequently result in being prepared for a "hard pull" by added momentum and vice versa. Too much momentum is sometimes carelessly attained just before the "dozer" noses into a heavy bank of dirt, and derailment occurs. Ordinary care and attention to these elementary details, simple as they may seem, is often difficult to obtain and repeated instructions and cautions are necessary to attain the desired results.



Lidgerwood Unloader in Action; Jordan Spreader in Operation.

Unloading with center or side plow and Lidgerwood apparently does not present many difficulties, but the numerous accidents which occur show that the man in charge has a herculean task before him in keeping machinery in working order and cars on the rails. For instance, we have seen an inexperienced train crew try to unload with a center plow on a 12 degree curve without securing the plow cable at any point between the Lidgerwood and the rear of a train of 10 cars. In this case the plow cable jumped the sides of the Gondola cars and pulled the plow through the side of the rear car without moving it a foot forward in the car. Civil engineers and foremen frequently leave the elementary unloading details to the train crew, but mishaps like the one quoted above may often be prevented by properly cautioning and instructing train crews in the simplest and most elementary details of the work required of them.

Economy and efficiency in construction and maintenance work depend to a large extent on efficient work train service. To secure this, experience teaches that the utmost care should be taken with the minutest details of the elementary work, especially with inexperienced train men. A new crew is best "broken in" by personal instruction and supervision, and when possible the civil engineer or foreman should work with the crew until satisfied that the men understand their duties, and more especially understand how to perform their duties in the most efficient manner.

WHERE TO OBTAIN FUTURE SECTION FOREMEN.

D. C. Davis, Roadmaster.

There have been many articles written upon the subject of where the future foremen for the railroads of the country are to be obtained.

This problem is getting serious, for we see almost daily the present forces leaving and taking up some other lines of work and you find their places being filled with many self-estimated men that are entirely incompetent and would not even make good laborers, as their conceit would not let them do a piece of work as directed, each believing his way to be the only proper way.

Some of these, and I might say a large per cent, have either been given the position by being related to or a pet of some official, or have purchased their places, either direct or indirectly, a thing that is being done far more than it would be policy to be made known publicly or to the higher officials. Nationality, society, relationship and similar considerations are taken as the requirements far more often than experience.

Today we have many foremen of this kind filling the places justly earned by others through years of practical experience. Such acts drive the latter away to other vocations against their wishes. Not only for this reason are responsible men turned away but there are various others, a few of which I will mention.

You will find from the superintendent to the laborer good men have been and are being forced to seek other employment. The practice of laying off men at almost any time of the year causes a large per cent to leave, as well as the low wages paid; but the most intelligent and competent are discouraged by roadmasters hiring outside men when the positions justly belong to them, as they have served faithfully for years with no other object in view than to get promoted when there was an opening.

If such men were promoted, they would no doubt be much better selections, the men not only having earned the positions but knowing each and every weak place to be looked after. An outsider would have to learn all this, entirely too often at the cost of property and sometimes death.

Then we have other reasons for the laborer leaving, one being the way they are classed by almost every one, but more especially by the train crews, which put them down as low, degraded beings, not much above the brute, and give them all kinds of abuse. The worst offenders are the "boomers" who have no homes and never pay their bills unless compelled to. Most of the officials and laborers in all other departments will snarl and make slurring remarks to or about track men whenever possible and at the same time they could not perform any of the work done by this ignorant section man, as they call him.

Again, there is scarcely a filthy job in any other department that the section men are not called upon to go and take care of; and if they refuse it is only a delay, for the superintendent will give the instruction that they must do as requested, instead of giving each department to understand that it must look after all kinds of work pertaining to its department. The poor unfortunate, through the desire to obtain the position of foreman, has endured all this. It is no wonder there are no laborers fit for foremen while such treatment as this is administered to them as a reward.

Not only this but many unreasonable instructions and reprimands are issued that even a laborer could improve, and with more benefit to the company's interest. To substantiate this statement I will give a few actual occurrences. Instruction was issued for all foremen to pick up all car and locomotive equipment fit for use, take it to their tool houses and keep same locked up; and when they had enough to justify it, ship it to the division master mechanic.

This instruction being complied with, the superintendent, on passing over the division, had an opportunity to look in a tool house and seeing some old hose and other pieces being taken care of, gave the foreman a reprimand in the presence of several other officials and his laborers, for having them in his tool house. Then he picked up the track gauge and wanted to know if the foreman ever used it and when he was informed that there was never a tie put in without using it, he remarked that if all foremen would do the same their track would ride much more level; which showed that he did not know the difference between a gauge and level.

We had another instance where the financial condition of the road was so low that all laborers were laid off and the foremen had to walk the track. This was in the spring when the grass had commenced to start and the farmers had taken their stock from their meadow land. The superintendent passed over the line and saw a foreman out with his hand car, leveling up some bad track and wrote the roadmaster about what a good, energetic man he had on this section. But in less than ten days he passed over again and noticed some meadow fence down, there being 15 or 20 panels where the fence had to be put up by nailing a board across the lower end of the post and be braced, as the land was too stony to dig post holes in, and the post and boards had all become so rotten that there was nothing to hold it up. The foreman had made a requisition for posts, fence boards and nails, and this the superintendent had turned down, and stated that he would have to do the best he could at present. So as there was no stock there the foreman had let it go unrepaired, as he had so many more things that required his attention in order to keep his track safe. But the superintendent wrote the roadmaster that he never saw a foreman so careless and neglectful as to allow his fence to be in such a condition.

This foreman saw both of these letters and the last discouraged him more than the first had encouraged him, and he was on the eve of quitting. I feel sure that he never had the same desire after that to make the efforts he had previously.

At a very important switching station the tracks had become very dilapidated—ties were rotten, rails worn out and broken so that the track was very unsafe. This condition had been brought on by not having material and help furnished to keep track up, and when they put on a heavier class of engines, the foreman gave it up as he could see nothing but derailments ahead and no prospects for material and help. Another foreman was put in this place and given a little more material and help and showed good results, having at least made a 100 per cent improvement, but he had not been able to get over all of the track, just looking after the ones most used first. There was an old, abandoned track covered up, with ties all rotten, which they commenced to use without giving him any notice or time to go over and repair it, with the result that the track spread and let a loaded coal car on the ground (as there was at least three inches of dirt on top) and when the engineer got a signal to stop he applied the air with such force that he threw the car across the main line, blocking it and breaking a switch stand. By clearing a parallel track no trains were delayed, yet the superintendent could not see or be made to understand anything but that it was the neglect and gross carelessness of the foreman and that he must be discharged. This was done and another put in his place, and it took him weeks to learn and understand the true conditions, and what should have special attention. He was not near as close an observer or as good worker, still it was the best that could be done at that time.

The train crew was not censured for its part, which was the main cause of the car being thrown across the track. It has been a positive fact that almost every derailment is charged against the track by the train crew, and their reports carry out this statement and say nothing about the true cause being their own or some other department's. You can almost invariably read one of them, and you have read or got the contents of all the others, which shows that they were either copied or that there was a verbal understanding as to what all would report. I could give a hundred instances where this has been carried on and many a foreman has thereby been discharged unjustly, but I will only mention one instance.

There was a derailment on a joint track stub switch and the train crew reported a lip on the slide rail. The roadmaster in charge got a roadmaster from another road and examined and confirmed the train crew's statement. This ordinarily would have fastened the blame on any foreman but for two reasons; first, the superintendent put but little confidence in a train man's report, saying that he invariably could rely upon a foreman if he wanted the facts and true cause; second, the foreman had followed this track for about four miles and could plainly see where something had been dragging, and by careful observation saw paint on the lead rails, and some wood on the end of the bolts; and opposite to these indications on side and top of the rail were plainly developed wheel marks that lead on to the slide rail, along top for about 12 feet and dropped off.

These marks were shown to the other roadmaster and he readily acknowledged the cause and wanted to correct his report but the clerk in the roadmaster's office would not let it be done. The same evening the superintendent came and made a personal inspection. And, by not knowing just which switch to look at and there being no foreman or laborers in sight, he asked a man who was standing near, who told him which switch and showed him where the train crew had carried the brake beam that had come down and caused the accident.

Now, why should the train crew go to all this trouble, cleaning up all scraps torn off and throwing the beam out in a high patch of weeds, if there could have been no blame placed against them?

Then I call to mind a case where a roadmaster had the foreman dig a ditch to lay a line of drain tile on each side of the track through a cut, and he had him cut a place four feet wide, straight down from the end of the ties and back to the ditch, doing this alternately, first on one, then on the other side, leaving four feet of dirt opposite each open to be filled when the tile was laid. The work was done as directed and when a passenger train (a fast through train) went over the dirt gave way and permitted the track to go out of line and derail several coaches and a Pullman sleeper. This was so plain a cause that the roadmaster placed the blame on the foreman, and he was taken out of the service, and for nothing more than obeying instructions. It would have been no use for him to make an effort to properly place the blame where it belonged, as no confidence would have been placed in what a foreman or laborer might say.

These are only a few of the many ways that foremen and laborers have to give up their positions, besides being ignored instead of commended for their loyalty and faithful discharge of duties at all times regardless of weather conditions. Then we must take under consideration the condition and surroundings in which they are placed and have to live and endure. You will find many a house without any conveniences and not infrequently one or two old dilapidated cast away box car bodies set off on the ground for houses, when they would make poor stables for a horse or cow.

Then the water that is furnished for them is often hauled from any pond or place where there is a tank, regardless of its purity, and put in shallow tubs, decayed and anything but sanitary; or frequently left in barrels or a tub car set on the side track, to catch all the dust from the air. Then we have a cistern filled from the roof without any filter, permitting the accumulated substances that are found on all roofs to wash into them, and the shallowness soon permits the mosquito parasite to hatch out and thicken the water so that it would be an impossibility to obtain a drink without consuming a goodly supply of them. Many places there is no effort made to furnish ice during the hottest of the summer season.

If the higher officials would make a close inspection and see these conditions and have a decent and respectable house, with good surroundings and conveniences furnished for their section foremen and laborers, it would be one of the biggest steps toward overcoming this serious future foreman problem. If the section house is supplied there should be a good garden spot and small buildings so that section men could keep a cow and raise a few hogs and chickens to furnish a part of their living, so that they could save a part of their earnings for later years, when they have to retire from the road.

To sum up all the causes that are driving the men from the track department; we find that they are slaves to all other departments, having to do without many comforts for the hardship they have to endure, being ordered about by all and in the most degrading way; their wages are the lowest of any class of laborers either on a railroad or anywhere, and even that is taken away from them at the will and pleasure of the officials, as this is invariably the first department ordered to retrench, regardless of the safety to the traveling public and trainmen.

The track condition should have the first consideration, then the rolling stock repairs should follow as a close second, in order to have a safe traffic carried on without the loss of life and property. All this could and should be remedied before it gets too far for redemption, and it can be done easily if the proper and higher officials will only make the investigation and see that the proper remedy is applied. From the start they will see an improvement in the class of labor and more energetic and substantial work being done; and in a few years there will be a first class force found on all sections with plenty of good, reliable men for foremen whenever one is desired. I believe that there should never be any one allowed to instruct or give section men orders but the roadmaster, except in cases of emergency, and then only in a gentlemanly way, and not as is general practice, as if they were slaves, too ignorant to understand firm and positive, mildly spoken instructions.

While I would not take any authority from an official, yet, I cannot help thinking that there is entirely too much direct action taken and harsh words spoken to or about foremen.

It is an easy matter to bring on discouragement that will produce bad results, by a hasty word spoken or written to a man that is carrying all the burden possible, and I have repeatedly seen a good, reliable foreman so discouraged that he could not be made to take any further interest with his work, but just drag along doing as little as possible and hold his position.

I believe it proper that superintendents should request an explanation of everything that does not have the proper appearance; but for him to call upon a foreman in almost every instance only has a bad effect and no good results. The same explanation could have been obtained through the roadmaster without any of these results.

When a superintendent is continually finding fault with everything a foreman does or what he thinks he has done, or left intentionally undone, asking for this and that explanation direct, without any reasonable cause for such treatment, we will find the foremen growing discouraged and careless and finally quitting. It also has an evil effect on whoever takes his place. It is my candid opinion that all officials have their spheres, and that they should be kept in the same, except when there may come up a neglect that must have immediate attention.

These statements as to causes why the better class of foremen are leaving and a lower grade taking their places, may be considered too severe, and conditions not as bad as depicted, but I can produce substantial proof that I have not made it strong enough.

Theory is good, but it takes actual experience and practice to make a good, reliable foreman, and all the schooling of clerks, as some have suggested, will never accomplish the desired results. A foreman may not be able to give any theoretical reasons for his methods, yet he will put up a piece of track that no theoretical man without practice could. Therefore we should seek to educate foremen direct by actual practice on the track daily, if the improvement desired is to be obtained.

EXTRA GANGS FOR RELAYING AND BALLASTING TRACK.

By E. E. Jewell, Foreman.

I do not favor section gangs being large enough to do extra work, such as laying rails or unloading ties and ballasting track.

Neither do I favor combining section gangs together to do work, as it takes them too far away from home and if hand cars are used, it tires the men so to pump them that they are not fit to do a day's work after reaching their destination.

Extra gangs, as a general rule, do not do their work as it should be done, but if section gangs are of sufficient size, say 1½ men to a mile of track, the section gang could follow them and finish what was not properly done. Work done by extra gangs does not, as a general rule, give good satisfaction.

The advantage of having extra gangs to do extra work is that it keeps section gangs at home, where they should be.

It is easier to obtain extra gang help than section help, for the reason that extra gangs run around a good deal and do not put in the hours a section gang does. And another thing, the larger the gang the less each man works.

Section gangs should not be made large enough to do reballasting, except possibly short strips, say one mile each year.

I object greatly to mixing extra gangs with section gangs. Where they work together the extra gang men will talk to section men and get them discontented. And the section men will soon leave the section and go with the extra gang. The best way is to give each section what men are needed to keep the section in good shape, and if required to put in a mile of ballast each year, but section gangs should not be taken from their sections. They do not like to go away from home to help some other gang out.

"MUD HOLES."

J. H. Hendricks, Supervisor.

I have had some very bad slides and find the best ballast to repair them with is cinders, as this seems to let the water out and holds the embankment at the same time.

I have had some very bad places in track which trackmen call mud holes, 90 to 100 feet in length, and I have repaired three different places by digging all the ballast out from under the ties, then taking out the mud and putting in one man riprap about 12 inches thick, covering with about 6 inches of cinders, and then filling the ballast back in the full width of the roadbed. After a heavy rain, before these mud holes were fixed, we had to put on slow orders, but since we have repaired them in this way we have had no more trouble.

I have three miles of track running through swamp and gumbo, and the roadbed was made out of this material, that is out of gumbo, on which we are unable to keep track up for fast speed. We have tried several different kinds of ballast and for the last few years we have been ballasting it with cinders, which seems to be the best of any for this kind of soil. We have put in cross drains of tile every 50 feet, but it does not seem to help very much, as the ballast goes down and forces the gumbo out at the sides of the track. I do not believe anything will do much good toward getting fast speed track out of it until the ballast works down to a good solid bed.

The memory of the late J. T. Harahan, president of the Illinois Central Railroad, is being perpetuated by the construction of a heavy bridge across the Mississippi River from Memphis to Arkansas. The bridge is being constructed by the Rock Island, the Missouri Pacific and the Cotton Belt roads. It will be a double-track structure of cantilever design, and will furnish two roadways for wagon and automobile traffic as well as additional railroad facilities. Ralph Modjeska of Chicago is the engineer in charge. The J. T. Harahan bridge, as it will be termed, will be 75 feet above the high water mark of 1887. Its longest span will measure 790 feet.

Correspondence.

BAD GAUGE.

Editor *Railway Engineering:*

Some very interesting occurrences have come to my notice in regard to bad riding track, which I will try to explain. Almost any track foreman can tell a low joint when he sees it, and can correct it without much trouble, but after getting low places up and fairly good line on his track, he still wonders why his track does not ride good. Here is the answer—*bad gauge.*

It is a fact that track that has been laid for a number of years gets wide in places, and in more places than most foremen have any idea of, especially when track is laid on soft ties and without ballast, causing the track to get center bound. This causes rails to tip over and force the outside of the base into the tie. This defect can be overcome with the use of tie plates, and especially on curves, tie plates should be used on every tie.

I have noticed some foremen who try to keep their gauging done by picking out the places that are a half inch wide and leaving places that are one quarter inch wide. This should not be done. When track runs from one quarter to one half inch wide, a foreman should start at one end of his section and line his line rail perfectly, then pull up the gauge side and after adzing all cut ties and plugging all spike holes, draw the rail to perfect gauge.

I believe, from my experience, that there is nothing more important for good riding track than perfect gauge, and it is looked after less than anything else. Lots of foremen think that as long as the rail is straight, it is all that is required. For example: I had a piece of track, about one mile long, that was very bad gauge when I took charge of this section. The year before it had been lined and the bad gauge places were divided in the lining to get a reasonable straight line on each rail. Thus it was hard to tell from looking at it if the gauge was anywhere near right. This track rode very badly and was in fair surface too. I worked on this piece of track 3 weeks with one man, and put it to good gauge. There has been no raising done on this piece of track since then (three years ago), and it still rides very good.

A foreman can take one good man and gauge between three and four hundred feet per day. Of course at this time of year with other things to look after, a man can't accomplish much with one man. But if he will keep persistently at it, in a few months he will have a nice little start and will have the satisfaction of seeing a great improvement in the riding of trains over track thus worked over.

H. D. Cramblit, Fmn.

MAINTENANCE METHODS.

Editor *Railway Engineering:*

In the December number of RAILWAY ENGINEERING, page 562, I notice an editorial headed "Maintenance Methods," and dealing with the relative value of large and small gangs in track maintenance: In this connection I would like to give you an experience of my own. We were doing ballasting on the division, the work of raising the track was being done with large gangs and the results were not only poor work but relatively poor quantity. This the officials appeared to attribute to the scarcity of laborers, a knowledge of which caused the laborers to be indifferent as they felt that their positions were secure. As the season advanced it was found that we were falling behind and would not be able to complete the work laid out for the season with the force then employed. The general superintendent ordered another extra gang organized. Not being in favor of big gangs in all cases and being in possession of what I considered absolute facts, one of which is that every man has his limit of capacity, another, that the ordinary extra gang of one hundred or more men is a gang far in excess of the ordinary foreman's ability to handle profitably, I suggested that if allowed to increase the section gangs on a section where we had put out ballast but had not been able to

reach with extra gang, I would guarantee to put up fifty feet of track per man per day, an average lift of eight inches, and renew all bad ties, which averaged five to the rail length. This proposition was very quickly taken up and authority given to increase the section gang, which I did to twelve men and foreman, with the result that I was able to get better than fifty feet per man, with a much better job of surfacing and trimming, with all new ties properly spiked and with much better results in every way.

It may be argued that fifteen or twenty men cannot always be handled at the ordinary section house. That may be so, but I am not dealing with that phase of the question. My contention is that if there is a man who can handle more than twenty or twenty-five men surfacing track and get a day's work out of each man, and have that work put to the best advantage, he is much above the average; and I have not come in contact with one like him in my thirty years as a trackman, except in cheap hotels, where men of a certain class tell what they have done in years gone by in some locality so far removed from the location of the story that it would not be worth while to investigate.

Efficient track-surfacing can only be done when each man engaged in tamping ties is directly under the eye of a competent man; that is, one who knows how to tamp a tie himself and will not stand for the practice, common, I am sorry to say among foremen as well as men, of piling ballast to top of tie before starting to tamp. The man who will allow this practice is not competent and if the balance of the operation has like supervision, the gang will be about 60 per cent efficient, whether it be large or small. There is a science in tamping ties which from the absence of the mention of it in any article I have seen or read on track maintenance, leaves the impression with me that it is not commonly known to writers of such articles; or is it that I am mistaken and the knowledge is so common that it is not considered necessary to mention it? I am doubtful, but not being able to deal with the question of the relative value of large and small gangs without going into detail, and not wishing to open a subject that others do not appear to consider requires discussion, I will close by stating I am ever in opposition to raising track and piling ballast on side of tie and then expecting track to stay to surface, to shooting hot air around the bunk cars at night, or into the ear of some official so far removed from the many little secrets of efficient track work that it is impossible for him to know of their existence. Competent supervision tends to produce competent workmen. No man can supervise the work of one hundred men surfacing track, at least this is my opinion borne out by long practice and close observation.

A Trackman from the North.

CONFERENCES ON RUSH WORK.

In order to expedite the work on the Statler Hotel in Cleveland, the engineer instituted daily meetings of the subcontractors to line up the work. At these meetings the work of the different trades was taken up and each sub-contractor stated if he was and why he was being hampered in his work. At these meetings the difficulties were thrashed out and the entire work harmonized.

The engineer might have attempted to decrease friction by his arbitrary demands, but the results attained more than justified his plan of co-operation. Each contractor was made to feel that he was getting a square deal, which resulted in better work, in addition to increased speed of work.

The Fox Construction Company, of El Reno, Okla., has been awarded the contract for constructing a subway on Georgia avenue in Memphis, Tenn., which will be used as an approach to the new freight terminal being built in that city by the Chicago, Rock Island and Pacific Railway. Work on the subway will be begun at once, and it is expected the improvement will be completed in four months.

AWARD OF MAINTENANCE PRIZES.

The track of the Chicago, Rock Island & Pacific Ry. is inspected twice a year by a committee consisting of the general manager, assistant general manager, when practicable, and always the engineer maintenance of way and division superintendents, who are the judges. Markings are made of the condition of the track on the spring inspection and again on the fall inspection after the track work has been completed. Markings are made on the following basis:

1. Line and surface; value, 65 marks (maximum).
2. Ditches, drainage and roadbed; value, 15 marks (maximum).
3. Frogs, switches and joints; value, 10 marks (maximum).
4. Spacing of ties; value, 5 marks (maximum).
5. Right-of-way, fences and station grounds; value, 5 marks (maximum).

Due consideration is given to the character of work which has been done on the section, amount of force employed, amount of money spent, whether or not ballasting or rail laying work has been done, and the physical characteristics of the section itself, and dependent upon these conditions the prize is awarded to the man who has made the greatest improvement between the spring and fall inspections. A prize is awarded to one section foreman on each roadmaster's territory, and to one roadmaster on each division.

There are, of course, some objections to this plan of awarding the prizes, but the judges endeavor to take everything into consideration, as far as practicable, before awarding them.

Following is a list of those taking prizes for the season of 1913:

First District.

Chicago Terminal Division—C. A. Barr, roadmaster; B. Carroll, section foreman.

Illinois Division—E. Ristau, section foreman; W. Johnson, section foreman; J. S. Darby, section foreman.

Iowa Division—T. O'Brien, roadmaster; R. Hannaford, section foreman; J. Newbauer, section foreman; F. Ransdell, section foreman.

Missouri Division—R. Stanley, roadmaster; J. T. Selix, section foreman; S. J. Pulse, section foreman; C. R. Myers, section foreman; J. Danaher, section foreman.

Cedar Rapids Division—C. Linehan, roadmaster; P. C. Ross, section foreman.

Minnesota Division—J. McNulty, roadmaster; S. Bowen, section foreman; T. Willaby, section foreman; B. Olegniczak, section foreman.

Dakota Division—J. W. Petersen, roadmaster; C. McMahon, section foreman; G. Adolph, section foreman; F. Brulek, section foreman; J. Tholke, section foreman.

Des Moines Valley Division—S. Hynes, section foreman; H. C. Waddle, section foreman.

Second District.

St. Louis Division—N. T. Blackwell, roadmaster; W. C. Eilers, section foreman; E. Buehrlin, section foreman; S. J. Burton, section foreman.

Kansas Division—W. Broddle, roadmaster; S. H. Bolander, section foreman; Wm. Clarke, section foreman; Wm. Stanton, section foreman.

El Paso Division—A. Shumate, roadmaster; David Burns, section foreman; I. M. Personett, section foreman; O. R. Packebush, section foreman; Fred Anderson, section foreman.

Nebraska Division—J. L. Hayes, roadmaster; C. D. Lucky, section foreman; Wm. Doyle, section foreman; Jno. Baxter, section foreman.

Colorado Division—H. O. Sinsabaugh, roadmaster; Frank Ames, section foreman; Chas. Keliher, section foreman.

Third District.

Arkansas Division—R. E. Herndon, roadmaster; John Murphy, section foreman; Tom Clements, section foreman; J. C. Harrison, section foreman.

Louisiana Division—C. H. Carpenter, roadmaster; W. Southall, section foreman; I. H. Ray, section foreman.

Indian Territory Division—J. Bolton, roadmaster; W. F. Pointer, section foreman; J. Lindsay, section foreman; J. Bolton, section foreman.

Oklahoma Division—Geo. Woods, roadmaster; Wm. Ray, section foreman; J. A. Thompson, section foreman.

Pan Handle Division—*Geo. Woods (Okla. Div.), roadmaster; A. Z. Gault, section foreman.

Amarillo Division—W. H. Gruhlkey, roadmaster; D. W. Hinkle, section foreman.

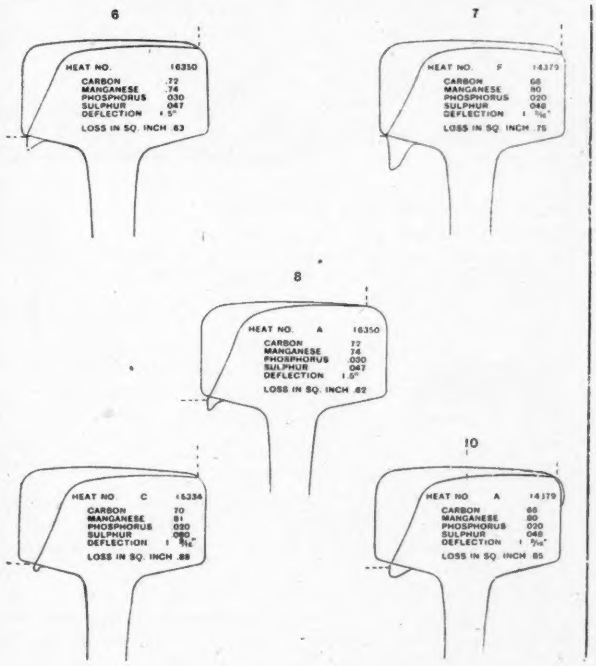
Southern Division—*W. H. Gruhlkey (Am. Div.), roadmaster; Thos. Standfield, section foreman.

*Territory extends over parts of two divisions—one premium awarded only.

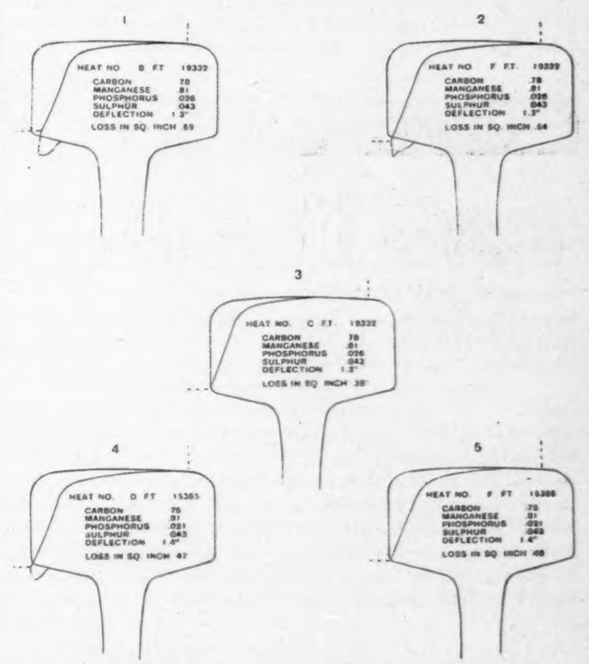
COMPARISON OF RAIL WEAR.

Tests of rail wear on the Lehigh Valley R. R. have been carried on, and the result of an inspection by Robert W. Hunt & Co., made April 15, 1912, has been issued.

The rails used in the test were (1) ordinary open-hearth steel rails rolled by the Bethlehem Steel Co., 90-lb. A. S. C. E section; and (2) open-hearth steel treated with 5/100 of 1% (0.05%) of metallic titanium, rolled at the same mill.



Bessemer Steel Rail Wear Diagrams.



Wear Diagrams, Titanium Treated Rails.

The titanium treated rails, illustrated herewith, were those laid on the high or elevated rail of a 6 deg. 16 min. curve on the Lehigh Valley R. R. east-bound track near Mooshead, Pa. The gradient is 1.3% down, so that it is probable that most trains hit this curve under high speed and have an application of air brakes throughout the curve. The rail wear under these conditions is, of course, severe. The rails were measured after having been in service for 20 months.

The open-hearth rails, of which wear diagrams are also shown, are located near Braden, Pa., and are also on a 1.3% descending grade. The curvature, however, is a little less severe, being 5 deg. and 56 min. The rails were rolled in 1908, were laid in August, 1910, at the same time as the titanium treated rails, and were inspected after 20 months' service, that is, the same time as the titanium treated rails were inspected.

The rail wear diagrams show the composition of the tested rails, and the loss in square inches.

The average loss in the five sections of the titanium treated rails was 0.484 sq. in., on the 6 deg. 16 min. curve. The average wear on the five sections of the open-hearth rails on the 5 deg. 56 min. curve was 0.748 sq. in. The addition of 0.05% of titanium increased the resistance to wear in the ratio of 1 to 1.54, or more than 33⅓%.

Personals

Although we are publishing monthly in these columns a practically complete report of all apointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

W. J. BUTLER has been appointed roadmaster and trainmaster of the *Alton, Jacksonville & Peoria Ry.*, office at Alton, Ill., succeeding J. B. McDonnell, who is now employed by the Standard Oil Co.

B. D. DEAN has been appointed general foreman of the *Boston & Maine R. R.*, at Boston, Mass.

E. HAYSTEAD has been appointed assistant roadmaster of the *Canadian Northern Ontario Ry.*, at Sydenham, Ont.

P. FRASER has been appointed roadmaster of the *Canadian Pacific Ry.*, at Broadview, Man., succeeding N. Lillis. A. KING has been appointed roadmaster at Aroostook Junction, N. B., succeeding A. CLOUTIER. J. MIKKELSON has been appointed roadmaster at Revelstoke, B. C., succeeding W. LOFTUS.

A. L. CLAPP, formerly roadmaster of the *Chicago & North Western Ry.*, at Wall Lake, Ia., has been appointed roadmaster at South Pekin, Ill. F. EGGLESTON has been appointed roadmaster at Mason City, Ia., succeeding M. MCFADDEN. A. PETERSON, formerly roadmaster at Sterling, Ill., has been appointed roadmaster at Wall Lake, Ia., succeeding MR. CLAPP.

O. W. HIPPERT has been appointed assistant roadmaster of the *Chicago, Burlington & Quincy R. R.*, at St. Louis, Mo.

W. H. WALKER, roadmaster of the *East Carolina Ry.*, has been transferred from Mowry to Hookerton, N. C.

The headquarters of E. TRENHOLM, supervisor of track of the *Erie R. R.*, have been moved from Avon to Wayland, N. Y.

P. SWEENEY has been appointed roadmaster of the *Galveston, Harrisburg & San Antonio Ry.*, at San Antonio, Tex., succeeding N. B. ROULINGS.

B. A. GUILL has been appointed roadmaster of the *Georgia R. R.*, at Camak, Ga.

G. R. OWEN has been appointed assistant roadmaster of the *Great Northern Ry.*, third district Kalispel division, succeeding A. F. MANLEY, resigned.

R. L. HATFIELD has been appointed roadmaster of the *International & Great Northern Ry.*, at Palestine, Tex., succeeding O. SUBLETTE.

A. B. GLOSTER, formerly assistant engineer, has been appointed roadmaster of the *Louisville & Nashville R. R.*, at Etowah, Tenn., succeeding G. K. McCORMICK. W. S. MOORE has been appointed roadmaster at Versailles, Ky. J. T. BUFFINGTON, supervisor, has been transferred from Bay Minette, to Opp, Ala. W. P. HAYDEN has been appointed supervisor at Richmond, Ky. W. T. HOLT has been appointed supervisor at Birmingham, Ala. THOS. KELLER, supervisor, has been transferred from Paris to Butler, Ky. H. R. KIRBY, supervisor, has been transferred from Opp to Bay Minette, Ala. B. S. SNEED, supervisor, has been transferred from Canton to Blue Ridge, Ga. J. T. WALKER, supervisor, has been transferred from Williamsbury, Ky., to La Follette, Tenn. R. D. WATKINS, supervisor, has been transferred from Erin, Tenn., to Guthrie, Ky. GEO. WESSON, supervisor, has been transferred from Pulaski to Columbia, Tenn.

S. G. QUINLISK, roadmaster of the *Missouri, Kansas & Texas System*, has been transferred from Parsons, Kan., to Sedalia, Mo.

JOHN DOYLE has been appointed roadmaster of the *Pere Marquette R. R.*, at Grand Rapids, Mich. R. A. MEIER has been appointed roadmaster at Edmore., Mich, succeeding S. S. SMITH, appointed roadmaster at Saginaw, Mich.

J. REDDY, roadmaster of the *Southern Pacific Co.*, has been transferred from Carlin to Montello, Nev.

J. C. DRAKE has been appointed roadmaster of the *Texas & New Orleans R. R., at* Jacksonville, Tex., succeeding W. E. Whitsett.

CHAS. PALMER, supervisor of the *Wabash R. R.*, at Montpelier, O., has been appointed supervisor at Peru, Ind.

With The Manufacturers

New Literature

Leaflet 79, HAYES TRACK APPLIANCE COMPANY, Richmond, Ind., describes and illustrates Hayes derails, CX and EX, for repair track protection. Particulars as to the operation and adaptation of the different sizes and types are given clearly.

* * *

Bulletin 111 has recently been issued by the U. S. LIGHT & HEATING COMPANY, Niagara Falls, N. Y., describing U. S. L. storage batteries for ignition and electric lighting. In addition to descriptions and illustrations, this book contains comprehensive information on storage battery ratings, tables and formulas, which make it easily possible for anyone to determine just the right size of battery for any particular service. The type of battery described is used extensively for signal service.

* * *

Catalogue E, 1914, has been issued by the BROWN HOISTING MACHINERY COMPANY, Cleveland, O. The catalogue gives descriptions of Brownhoist grab buckets, slag buckets, contractors' grab buckets, and various kinds of tubs for handling coal, ore, sand, etc. The typography and illustrations are excellent, the catalogue being a high class reproduction of decided value to those interested in buckets.

* * *

THE CONNEAUT SHOVEL CO., Conneaut, O., has issued a new catalogue of its line of shovels, devoted to its special hand-made, strap back shovels. These, with other lines, give this company over 1,150 styles and sizes. The illustrations are attractive, and the typography excellent. The information given is of value to all shovel users.

* * *

THE WEIR FROG CO., Cincinnati, O., has issued Catalogue No. 9. It illustrates and describes the extensive line of track materials and supplies manufactured by this concern. Complete description, accompanied by illustration, is given of a large number of designs of frogs, switches, crossings, and switch stands. Track work is of both ordinary and hard steel designs. The catalogue is a very handy size, and will be mailed to anyone interested on request.

* * *

One of the most distinctive catalogues recently distributed is Catalogue 614, of the NOVO ENGINE CO., of Lansing, Mich. The typography and general makeup are unusually attractive. Novo gasoline engines occupy the main portion of the booklet, and the clear detailed description and illustration of each working part gives an excellent idea of the construction of the engine. Anyone interested in gasoline engines will find this catalogue valuable.

The Selling Side

A. E. Schafer has been appointed assistant to president of the FLINT VARNISH WORKS, Flint, Mich.

Erich Joseph, formerly New York manager, has been appointed general manager of the ORENSTEIN-ARTHUR-KOPPEL CO., office at Koppel, Pa., succeeding A. Reiche, resigned to engage in business in Germany.

At the annual meeting of the ways and means committee (subdivision No. 24) of the Chicago Association of Commerce, held at the Hotel LaSalle, Monday, December 22, MR. ALLEN SHELDON, manager of the RAILWAY SUPPLY PERMANENT EXHIBIT, located in the Karpen building, was elected chairman of subdivision No. 24, effective January 1.

Subdivision No. 24 of the Chicago Association of Commerce is the committee dealing with matters pertaining to railway supplies, and the selection of Mr. Sheldon to direct the activities of the association in this important branch of commercial enterprise is a wise and logical move. For the past two years his entire time has been spent among the railway supply manufacturers and jobbers of the United States in the interests of the Railway Supply Permanent Exhibit, and his acquaintance and knowledge in this field should result in lasting benefit to the manufacturing interests of the city of Chicago.

Mr. George F. Maddock, M. Am. Soc. M. E., has been appointed manager of the department of examinations and reports of H. M. BYLLESBY & CO., Engineers, Chicago, Ill.

THE DE LAVAL STEAM TURBINE COMPANY has appointed as Chicago manager, with offices in the People's Gas Building, Mr. S. Wolff, formerly manager of the Cleveland office of the Allis-Chalmers Manufacturing Company.

MR. GUSTAV LINDENTHAL, M. Am. Soc. C. E., Consulting Engineer, New York City, has been awarded a gold medal at the International Exhibition at Leipzig, Germany, for the design and plans of the Hell Gate steel arch bridge of the New York Connecting R. R., described in our issue of Jan. 8.

Mr. Charles H. Eglee, Assoc. Am. Soc. C. E., for nine years general manager of the Ambursen Hydraulic Construction Co., Boston, Mass., in charge of construction work, has resigned

ALLEN SHELDON, Manager
Railway Supply Permanent Exhibit.

to become connected with the ABERTHAW CONSTRUCTION Co., also of Boston, and will have charge of all dam and reservoir work for this company, which has recently added a dam-building division to its other concrete construction departments. Mr. Eglee is a native of Boston and has been a waterworks contractor since 1883, when he was admitted to the firm of Henry Lewis, contractor, of Boston. In 1885 he established a contracting business under his own name.

At the annual meeting of the stockholders of the Ohio Ceramic Engineering Company, of Cleveland, resolutions were adopted changing the corporate name to THE LAKEWOOD ENGINEERING COMPANY. For several years past this company has applied the trade name "Lakewood Line" to all its products, consisting of contractors' equipment, concrete mixers, towers, chutes, buckets, etc., and also industrial cars and factory trucks of all kinds. About six years ago the company took up the manufacture of concrete mixers and has gradually developed this line, until today this department represents fully one-half of the output of the company. At the annual meeting the old board of directors and officers, consisting of Frank H. Robinson, president; Charles F. Lang, vice-president and general manager; A. W. Stone, secretary; Hon. James H. Cassidy and Robert Kline, were re-elected. Mr. D. L. Wadsworth is sales manager and Mr. Henry T. Pleines, superintendent.

Mr. Arthur C. Toner, Assoc. M. Am. Soc. C. E., formerly assistant engineer of the Baltimore sewerage commission, has been appointed engineer of the ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS, with offices in Philadelphia, Penn.

THE CERESIT WATERPROOFING COMPANY, of Chicago, has received two awards during the past year, both won by Ceresit Waterproofing Compaund—the prize at the world exposition at Ghent, Belgium, and a gold medal at the International Exposition of Building Materials at Leipzig.

The tenth annual convention of the sales and factory organizations of the CHICAGO PNEUMATIC TOOL COMPANY was held at the Great Northern Hotel, Chicago, last week. About one hundred of the company's representatives were in attendance from all parts of the world.

THE DES MOINES BRIDGE & IRON COMPANY, of Pittsburgh and Des Moines, has opened a contracting office at 50 Church street, New York City. Mr. J. E. O'Leary, one of the company's contracting engineers, is in charge of the office, which will handle the business in the coast states north of Virginia and in Eastern Canada.

The Browning Engineering Co., Cleveland, has changed its name to THE BROWNING CO.

ANNUAL TRACK APPLIANCE EXHIBIT.

The annual exhibit of the Track Appliances Association bids fair to equal or exceed in importance any exhibit that has gone before. A larger attendance of railway men can be confidently expected. The following firms have already reserved space and will have exhibits at the show:

Adams & Westlake Co., The, Chicago, Ill.
Ajax Forge Co., Chicago, Ill.
Ajax Rail Anchor Co., Chicago, Ill.
American Guard Rail Fastener Co., Philadelphia, Pa.
American Hoist & Derrick Co., St. Paul, Minn.
American Rolling Mill Co., The, Middletown, Ohio.
American Steel & Wire Co., Chicago, Ill.
American Valve Meter Co., The Cincinnati, Ohio.
American Vulcanized Fibre Co., Pittsburgh, Pa.
Asphalt Ready Roofing Co., New York, N. Y.
Atlas Preservative Co. of America, New York, N. Y.
Barrett Mfg. Co., New York, N. Y.
Bausch & Lomb Optical Co., Rochester, N. Y.
Louis Blessing, Jackson, Mich.
S. F. Bowser & Co., Ft. Wayne, Ind.
L. S. Brach Supply Co., New York, N. Y.
Brown Rail Loader, James C. Barr, Mgr., Boston, Mass.
Bryant Zinc Co., Chicago, Ill.
Buda Co., The, Chicago, Ill.
Buyers' Index Co., Chicago, Ill.
Philip Carey Co., The, Lockland, Cincinnati, Ohio.
Carnegie Steel Co., Pittsburgh, Pa.
Geo. B. Carpenter & Co., Chicago, Ill.
Chicago Bridge & Iron Works, Chicago, Ill.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Frog & Crossing Co., Cleveland, Ohio.
Clyde Iron Works, Duluth, Minn.
Commercial Acetylene Ry. Light & Signal Co., Chicago, Ill.
Concrete Steel Co., Chicago, Ill.
Conley Frog & Switch Co., Memphis, Tenn.
Crerar, Adams & Co., Chicago, Ill.
Curtain Supply Co., Chicago, Ill.
D. & A. Post Mold Co., Three Rivers, Mich.
Des Moines Bridge & Iron Co., Des Moines, Iowa.
Detroit Graphite Co., Detroit, Mich.
Paul Dickinson, Inc., Chicago, Ill.
Dilworth, Porter & Co., Pittsburgh, Pa.
Joseph Dixon Crucible Co., Jersey City, N. J.
G. Drouve Co., The, Bridgeport, Conn.
Duff Mfg. Co., The, Pittsburgh, Pa.
Duplex Metals Co., New York, N. Y.
Eastern Granite Roofing Co., The, New York, N. Y.
E. D. E. Co., Chicago, Ill.
Thomas A. Edison, Inc., Orange, N. J.
Edison Storage Battery Co., Orange, N. J.
Electric Storage Battery Co., The, Philadelphia, Pa.
Elyria Iron & Steel Co., The, Elyria, Ohio.
Fairbanks, Morse & Co., Chicago, Ill.
Fairmont Machine Co., Fairmont, Minn.
Federal Signal Co., Albany, N. Y.
Frictionless Rail, The, Boston, Mass.
Galion Iron Works Co., Galion, Ohio.
General Electric Co., Schenectady, N. Y.
General Ry. Signal Co. of Canada, Ltd.
General Railway Signal Co., Rochester, N. Y.
Gordon Primary Battery Co., New York, N. Y.
Grip Nut Co., Chicago, Ill.
Gurley, W. & L. E., Troy, N. Y.
Haggard & Marcusson Co., Chicago, Ill.
Hall Switch & Signal Co., New York, N. Y.
Hammond, R. R., & Co., Philadelphia, Pa.
Hayes Track Appliance Co., Richmond, Ind.
Hobart-Allfree Co., The, Chicago, Ill.
Hoeschen Mfg. Co., Omaha, Nebr.
Hubbard & Co., Pittsburgh, Pa.

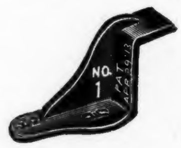
Illinois Steel Co., Chicago, Ill.
Indianapolis Switch & Frog Co., The, Springfield, Ohio.
International Harvester Co. of America, Chicago, Ill.
H. W. Johns-Manville Co., Chicago, Ill.
O. F. Jordan Co., The, Chicago, Ill.
Joyce-Cridland Co., The, Dayton, Ohio.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Kelly-Derby Co., Chicago, Ill.
Kennicott Co., The, Chicago, Ill.
Kerite Insulated Wire & Cable Co., New York, N. Y.
Keuffel & Esser Co., Chicago, Ill.
Lackawanna Steel Co., Lackawanna, N. Y.
Lehon Co., The, Chicago, Ill.
Lidgerwood Mfg. Co., New York, N. Y.
Louisiana Red Cypress Co., New Orleans, La.
Lufkin Rule Co., The, Saginaw, Mich.
David Lupton's Sons Co., Philadelphia, Pa.
Maryland Steel Co., Philadelphia, Pa.
C. F. Massey Co., Chicago, Ill.
McGraw Publishing Co., New York, N. Y.
Morden Frog & Crossing Works, Chicago, Ill.
Mudge & Co., Chicago, Ill.
M. W. Supply Co., Philadelphia, Pa.
National Carbon Co., Cleveland, Ohio.
National Electric Specialty Co., The, Toledo, Ohio.
National Indicator Co., Long Island City, N. Y.
National Lock Washer Co., The, Newark, N. J.
National Malleable Castings Co., The, Cleveland, Ohio.
National-Standard Co., Niles, Mich.
George P. Nichols & Bro., Chicago, Ill.
Northey-Simmen Signal Co., The, Ltd., Indianapolis, Ind.
Ogle Construction Co., Chicago, Ill.
Okonite Co., The, New York, N. Y.
Spencer Otis Co., Chicago, Ill.
P. & M. Co., The, Chicago, Ill.
W. W. Patterson Co., Pittsburgh, Pa.
Pennsylvania Steel Co., The, Philadelphia, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Pocket List of Railroad Officials, New York, N. Y.
Positive Rail Anchor Co., Louisville, Ky.
Potter-Winslow Co., Chicago, Ill.
Q and C Co., The, New York, N. Y.
Rail Joint Co., The, New York, N. Y.
Railroad Supply Co., The, Chicago, Ill.
Railway List Co., Chicago, Ill.
Railway Engineering & Maintenance of Way, Chicago.
Railway Review, The, Chicago, Ill.
Ramapo Iron Works, Hillburn, N. Y.
Reading-Bayonne Steel Casting Co., Reading, Pa.
Revolute Machine Co., New York, N. Y.
Rhineland Machine Works Co., New York, N. Y.
Richards-Wilcox Mfg. Co., Aurora, Ill.
Roberts & Schaefer Co., Chicago, Ill.
Sellers Mfg. Co., Chicago, Ill.
Signal Accessories Co., The, New York, N. Y.
Simmons-Boardman Publishing Co., New York, N. Y.
T. W. Snow Construction Co., Chicago, Ill.
Standard Asphalt & Rubber Co., Chicago, Ill.
Standard Underground Cable Co., Pittsburgh, Pa.
Stark Rolling Mill Co., The, Canton, Ohio.
Steel Railway Tie & Appliance Co., Denver, Colo.
Templeton, Kenly & Co., Ltd., Chicago, Ill.
Union Draft Gear Co., Chicago, Ill.
Union Iron Works, Hoboken, N. J.
Union Switch & Signal Co., The, Swissvale, Pa.
United Electric Apparatus Co., Boston, Mass.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Verona Tool Works, Pittsburgh, Pa.
Waterbury Battery Co., The, Waterbury, Conn.
West Coast Lumber Mfrs.' Assn., Tacoma, Wash.
Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa.
Winans Improved Patent Rail Joint Co., Portland, Ore.
Horace L. Winslow, Chicago, Ill.
Wolfe Brush Co., Pittsburgh, Pa.
Wyoming Shovel Works, Wyoming, Pa.
Yale & Towne Mfg. Co., New York, N. Y.

COMBINATION RAIL BRACE AND TIE PLATE.

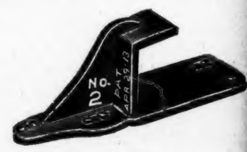
The illustration herewith shows the Perfect No. 2 combination tie plate and rail brace, which has some unusual features.

Like the combination braces and plates for guard rails, it is designed to prevent the rail from tipping or canting, and spreading is resisted not only by the spikes on the outside, but by the weight of the load on the plate, and by the spikes on the inside of the rails.

Tie plates have been advocated with a greater projection outside the rail, to produce additional resistance to the tipping tendency of the rail which tendency is always out or away from the track.



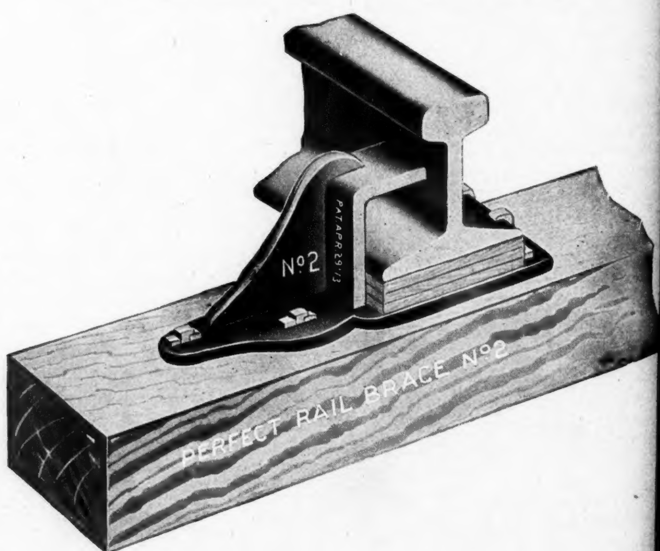
Perfect No. 1 Brace.



Perfect No. 2 Brace.

The rail brace shown herein has considerable greater bearing outside the rail than inside, and should effectually prevent canting.

The greatest advantage, however, is the adaptability of this brace to the use of shims. Practically always, when shims are used, the track must be braced because the spikes are raised up so high that they give insufficient lateral resistance. As ordinary braces are not designed to be used unless the rail sets on the tie,



Perfect No. 2 Brace in Applied Position.

it is customary to brace shimmed track, using some of the shim spiked endways against the outside of the rail, to hold track t gage. As shown in the illustration, with this brace, shims ma be used without raising the outside spikes, and the brace is effe tive after the track is shimmed.

The Perfect No. 1 brace is similar to the No. 2 without th tie plate feature. Both types are being marketed by the Kell Derby Co., Peoples Gas Bldg., Chicago.